CATEGORY 2 - MATERIALS PROCESSING

Note: *For quiet running bearings, see the U.S. Munitions List.*

A. SYSTEMS, EQUIPMENT AND COMPONENTS

2A001 Anti-friction bearings and bearing systems, as follows, (see List of Items Controlled) and components therefor.

License Requirements

Reason for Control: NS, MT, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
MT applies to radial ball bearings having all tolerances specified in accordance with ISO 492 Tolerance Class 2 (or ANSI/ABMA Std 20 Tolerance Class ABEC-9, or other national equivalents) or better and having all the following characteristics: an inner ring bore diameter between 12 and 50 mm; an outer ring outside diameter between 25 and 100 mm; and a width between 10 and 20 mm.	MT Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: $3000, N/A for MT
GBS: Yes, for 2A001.a, N/A for MT
CIV: Yes, for 2A001.a, N/A for MT

List of Items Controlled

Unit: $ value
Related Controls: (1) See also 2A991. (2) Quiet running bearings are subject to the export licensing authority of the Department of State, Directorate of Defense Trade Controls. (See 22 CFR part 121.)
Related Definitions: Annular Bearing Engineers Committee (ABEC).
Items:

Note: *2A001 does not control balls with tolerances specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse.*

a. Ball bearings and solid roller bearings, having all tolerances specified by the manufacturer in accordance with ISO 492 Tolerance Class 4 (or national equivalents), or better, and having both rings and rolling elements (ISO 5593), made from monel or beryllium;

Note: *2A001.a does not control tapered roller bearings.*

b. [RESERVED]

c. Active magnetic bearing systems using any of the following:

c.1. Materials with flux densities of 2.0 T or greater and yield strengths greater than 414 MPa;

c.2. All-electromagnetic 3D homopolar bias designs for actuators; *or*

c.3. High temperature (450 K (177°C) and above) position sensors.

2A101 Radial ball bearings having all tolerances specified in accordance with ISO 492 Tolerance Class 2 (or ANSI/ABMA Std 20 Tolerance Class ABEC-9 or other national equivalents), or better and having all the following characteristics (see List of

Items Controlled).

License Requirements

Reason for Control: MT, AT

Control(s)	*Country chart*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See ECCN 2A001.
Related Definitions: N/A
Items:

a. An inner ring bore diameter between 12 and 50 mm;

b. An outer ring outside diameter between 25 and 100 mm; *and*

c. A width between 10 and 20 mm.

2A225 Crucibles made of materials resistant to liquid actinide metals, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry.
Related Definitions: N/A
Items:

a. Crucibles having both of the following characteristics:

a.1. A volume of between 150 cm^3 and 8,000 cm^3; *and*

a.2. Made of or coated with any of the following materials, having a purity of 98% or greater by weight:

a.2.a. Calcium fluoride (CaF_2);

a.2.b. Calcium zirconate (metazirconate) ($CaZrO_3$);

a.2.c. Cerium sulphide (Ce_2S_3);

a.2.d. Erbium oxide (erbia) (Er_2O_3);

a.2.e. Hafnium oxide (hafnia) (HfO_2);

a.2.f. Magnesium oxide (MgO);

a.2.g.Nitrided iobium-titanium-tungsten alloy (approximately 50% Nb, 30% Ti, 20% W);

a.2.h. Yttrium oxide (yttria) (Y_2O_3); *or*

a.2.i. Zirconium oxide (zirconia) (ZrO_2);

b. Crucibles having both of the following characteristics:

b.1. A volume of between 50 cm^3 and 2,000 cm^3; *and*

b.2. Made of or lined with tantalum, having a purity of 99.9% or greater by weight;

c. Crucibles having all of the following characteristics:

c.1. A volume of between 50 cm^3 and 2,000 cm^3;

c.2. Made of or lined with tantalum, having a purity of 98% or greater by weight; *and*

c.3. Coated with tantalum carbide, nitride, boride, or any combination thereof.

2A226 Valves having all of the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NP, CB, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
CB applies to valves that also meet or exceed the technical parameters in 2B350.g	CB Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value

Related Controls: (1) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (2) Also see ECCNs 2A292 and 2B350.g. (3) Valves specially designed or prepared for certain nuclear uses are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).
Related Definitions: For valves with different inlet and outlet diameters, the "nominal size" in 2A226 refers to the smallest diameter.
Items:

a. A "nominal size" of 5 mm or greater;

b. Having a bellows seal; *and*

c. Wholly made of or lined with aluminum, aluminum alloy, nickel, or nickel alloy containing more than 60% nickel by weight.

2A290 Generators and other equipment specially designed, prepared, or intended for use with nuclear plants.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value

Related Controls: (1) See ECCN 2D290 for software for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E290 ("use") for technology for items controlled under this entry. (3) Also see ECCN 2A291. (4) Certain nuclear equipment specially designed or prepared for use in nuclear plants is subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).
Related Definitions: N/A
Items:

a. Generators, turbine-generator sets, steam turbines, heat exchangers, and heat exchanger type condensers designed or intended for use in a nuclear reactor;

b. Process control systems intended for use with the equipment controlled by 2A290.a.

2A291 Equipment, except items controlled by 2A290, related to nuclear material handling and processing and to nuclear reactors.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number; parts and accessories in $ value

Related Controls: (1) See ECCN 2D290 for software for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E290 ("use") for technology for items controlled under this entry. (3) Also see ECCN 2A290. (4) Certain equipment specially designed or prepared for use in a nuclear reactor or in nuclear material handling is subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110). (5) Nuclear radiation detection and measurement devices specially designed or modified for military purposes are subject to the export licensing authority of the Department of State (see 22 CFR Parts 120 through 130).
Related Definitions: N/A
Items:

a. Process control systems intended for use with nuclear reactors.

b. Simulators specially designed for "nuclear reactors".

c. Casks that are specially designed for transportation of high-level radioactive material and that weigh more than 1,000 kg.

d. Commodities, parts and accessories specially designed or prepared for use with nuclear plants (*e.g.*, snubbers, airlocks, pumps, reactor fuel charging and discharging equipment, containment equipment such as hydrogen recombiner and penetration seals, and reactor and fuel inspection equipment, including ultrasonic or eddy current test equipment).

e. Radiation detectors and monitors specially designed for detecting or measuring "special nuclear material" (as defined in 10 CFR Part 110) or for nuclear reactors.

Technical Notes:

1. 2A291.e does not control neutron flux detectors and monitors. These are subject to the

export licensing authority of the Nuclear Regulatory Commission, pursuant to 10 CFR Part 110.

2. 2A291.e does not control general purpose radiation detection equipment, such as geiger counters and dosimeters. These items are controlled by ECCN 1A999.

2A292 Piping, fittings and valves made of, or lined with, stainless steel, copper-nickel alloy or other alloy steel containing 10% or more nickel and/or chromium.

License Requirements

Reason for Control: NP, CB, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 2
CB applies to valves that meet or exceed the technical parameters described in 2B350.g	CB Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Pressure tubes, pipes, and fittings in kilograms; valves in number; parts and accessories in $ value
Related Controls: (1) See ECCN 2D290 for software for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E290 ("use") for technology for items controlled under this entry. (3) Also see ECCN 2A226. (4) Piping, fittings, and valves specially designed or prepared for certain nuclear uses are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).
Related Definitions: N/A
Items:

a. Pressure tube, pipe, and fittings of 200 mm (8 in.) or more inside diameter, and suitable for operation at pressures of 3.4 MPa (500 psi) or greater;

b. Pipe valves having all of the following characteristics:

b.1. A pipe size connection of 200 mm (8 in.) or more inside diameter; *and*

b.2. Rated at 10.3 MPa (1,500 psi) or more.

2A293 Pumps designed to move molten metals by electromagnetic forces.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: (1) See ECCN 2D290 for software for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E290 ("use") for technology for items

controlled under this entry. (3) Pumps for use in liquid-metal-cooled reactors are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2A983 Explosives or detonator detection equipment, both bulk and trace based, consisting of an automated device, or combination of devices for automated decision making to detect the presence of different types of explosives, explosive residue, or detonators; and parts and components, n.e.s.

License Requirements

Reason for Control: RS, AT

Control(s)	*Country Chart*
RS applies to entire entry	RS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: Also see 1A004 and 1A995.
Related Definitions: 1) For the purpose of this entry, automated decision making is the ability of the equipment to detect explosives or detonators at the design or operator-selected level of sensitivity and provide an automated alarm when explosives or detonators at or above the sensitivity level are detected. This entry does not control equipment that depends on operator interpretation of indicators such as inorganic/organic color mapping of the items(s) being scanned. 2) Explosives and detonators include commercial charges and devices controlled by 1C018 and 1C992 and energetic materials controlled by ECCNs 1C011, 1C111, 1C239 and 22 CFR 121.1 Category V.
Items:

***Note**: Explosives or detonation detection equipment in 2A983 includes equipment for screening people, documents, baggage, other personal effects, cargo and/or mail.*

a. Explosives detection equipment for automated decision making to detect and identify bulk explosives utilizing, but not limited to, x-ray (e.g., computed tomography, dual energy, or coherent scattering), nuclear (e.g., thermal neutron analysis, pulse fast neutron analysis, pulse fast neutron transmission spectroscopy, and gamma resonance absorption), or electromagnetic techniques (e.g., quadropole resonance and dielectrometry).

b.[RESERVED]

c. Detonator detection equipment for automated decision making to detect and identify initiation devices (e.g. detonators, blasting caps) utilizing, but not limited to, x-ray (e.g. dual energy or computed tomography) or electromagnetic techniques.

2A984 Concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution of 0.5 milliradian up to and including 1 milliradian at a standoff distance of 100 meters; and parts and components, n.e.s.

License Requirements

Reason for Control: RS, AT

Control(s)	*Country Chart*
RS applies to entire entry	RS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) Concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution less than 0.5 milliradian (a lower milliradian number means a more accurate image resolution) at a standoff distance of 100 meters is under the export licensing authority of the U.S. Department of State (22 CFR parts 120 through 130). (2) Concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution greater than 1 milliradian (a higher milliradian number means a less accurate image resolution) at a standoff distance of 100 meters is designated as EAR99. (3) See ECCNs 2D984 and 2E984 for related software and technology controls.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

Note*: *Concealed object detection equipment includes but is not limited to equipment for screening people, documents, baggage, other personal effects, cargo and/or mail.

Technical Note*: *The range of frequencies span what is generally considered as the millimeter-wave, submillimeter-wave and terahertz frequency regions.

2A991 Bearings and bearing systems not controlled by 2A001.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: 1.) This entry does not control balls with tolerance specified by the manufacturer in accordance with ISO 3290 as grade 5 or worse. 2.) Quiet running bearings are subject to the export licensing authority of the Department of State, Directorate of Defense Trade Controls. (See 22 CFR part 121).
Related Definitions: 1.) (a) DN is the product of the bearing bore diameter in mm and the bearing rotational velocity in rpm. (b) Operating temperatures include those temperatures obtained when a gas turbine engine has stopped after operation. 2.) Annular Bearing Engineers Committee (ABEC); American National Standards Institute (ANSI); Anti-Friction Bearing Manufacturers Association (AFBMA)
Items:

a. Ball bearings or Solid ball bearings (except tapered roller bearings), having tolerances specified by the manufacturer in accordance with

ABEC 7, ABEC 7P, or ABEC 7T or ISO Standard Class 4 or better (or equivalents) and having any of the following characteristics.

a.1. Manufactured for use at operating temperatures above 573 K (300 °C) either by using special materials or by special heat treatment; *or*

a.2. With lubricating elements or component modifications that, according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2.3 million DN.

b. Solid tapered roller bearings, having tolerances specified by the manufacturer in accordance with ANSI/AFBMA Class 00 (inch) or Class A (metric) or better (or equivalents) and having either of the following characteristics.

b.1. With lubricating elements or component modifications that, according to the manufacturer's specifications, are specially designed to enable the bearings to operate at speeds exceeding 2.3 million DN; *or*

b.2. Manufactured for use at operating temperatures below 219 K (-54 °C) or above 423 K (150 °C).

c. Gas-lubricated foil bearing manufactured for use at operating temperatures of 561 K (288 °C) or higher and a unit load capacity exceeding 1 MPa.

d. Active magnetic bearing systems.

e. Fabric-lined self-aligning or fabric-lined journal sliding bearings manufactured for use at operating temperatures below 219 K(-54 °C) or above 423 K (150 °C).

2A994 Portable electric generators and specially designed parts.

License Requirements

Reason for Control: AT

Control(s) *Country Chart*

AT applies to entire entry. A license is required for items controlled by this entry to Cuba, Iran and North Korea. The Commerce Country Chart is not designed to determine licensing requirements for this entry. See part 746 of the EAR for additional information on Cuba and Iran. See §742.19 of the EAR for additional information on North Korea.

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See also 2D994 and 2E994
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2A999 Specific processing equipment, n.e.s., as follows (see List of Items Controlled).

License Requirements

Reason for Control: AT

Control(s) *Country Chart*

AT applies to entire entry. A license is required for items controlled by this entry to North Korea for anti-terrorism reasons. The Commerce Country Chart is not designed to determine AT licensing requirements for this entry. See §742.19 of the EAR for additional information.

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See also 2A226, 2B350
Related Definitions: N/A
Items:

a. Bellows sealed valves;

b. Reserved.

B. TEST, INSPECTION AND PRODUCTION EQUIPMENT

Technical Notes for 2B001 to 2B009, 2B201, 2B290 and 2B991 to 2B999:

1. Secondary parallel contouring axes, (e.g., the w-axis on horizontal boring mills or a secondary rotary axis the center line of which is parallel to the primary rotary axis) are not counted in the total number of contouring axes. Rotary axes need not rotate over 360°. A rotary axis can be driven by a linear device (e.g., a screw or a rack-and-pinion).

2. The number of axes which can be coordinated simultaneously for "contouring control" is the number of axes along or around which, during processing of the workpiece, simultaneous and interrelated motions are performed between the workpiece and a tool. This does not include any additional axes along or around which other relative motions within the machine are performed, such as:

2.a. Wheel-dressing systems in grinding machines;

2.b. Parallel rotary axes designed for mounting of separate workpieces;

2.c. Co-linear rotary axes designed for manipulating the same workpiece by holding it in a chuck from different ends.

3. Axis nomenclature shall be in accordance with International Standard ISO 841, "Numerical Control Machines - Axis and Motion Nomenclature".

4. A "tilting spindle" is counted as a rotary axis.

5. 'Stated positioning accuracy' derived from measurements made according to ISO 230/2 (2006) may be used for each specific machine model as an alternative to individual machine tests. 'Stated positioning accuracy' means the accuracy value provided to BIS as representative of the accuracy of a specific machine model.

***Note to paragraph 5**: Determination of 'Stated Positioning Accuracy':*

a. Select five machines of a model to be evaluated;

b. Measure the linear axis accuracies according to ISO 230/2 (2006);

c. Determine the A-values for each axis of each machine. The method of calculating the A-value is described in the ISO standard;

d. Determine the mean value of the A-value of each axis. This mean value A becomes the stated value of each axis for the model ($\bar{A}x$ $\bar{A}y$...);

e. Since the Category 2 list refers to each linear axis there will be as many stated values as there are linear axes;

f. If any axis of a machine model not controlled by 2B001.a. to 2B001.c. has a stated accuracy $\bar{A}$ of 5 µm for grinding machines and 6.5 µm for milling and turning machines or

better, the builder should be required to reaffirm the accuracy level once every eighteen months.

6. Measurement uncertainty for the positioning accuracy of machine tools, as defined in the International Standard ISO 230/2 (2006), shall not be considered.

2B001 Machine tools and any combination thereof, for removing (or cutting) metals, ceramics or "composites", which, according to the manufacturer's technical specifications, can be equipped with electronic devices for "numerical control"; and specially designed components as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
NP applies to 2B001.a, .b, .c, and .d, EXCEPT: (1) turning machines under 2B001.a with a capacity no greater than 35 mm diameter; (2) bar machines (Swissturn), limited to machining only bar feed through, if maximum bar diameter is equal to or less than 42 mm and there is no capability of mounting chucks. (Machines may have drilling and/or milling capabilities for machining parts with diameters less than 42 mm); or (3) milling machines under 2B001.b with x-axis travel greater than two meters and overall positioning accuracy according to ISO 230/2 (2006) on the x-axis more (worse) than 22.5 µm.	NP Column 1
AT applies to entire entry.	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Machine tools in number; components in $ value
Related Controls: (1) See ECCN 2B002 for optical finishing machines. (2) See ECCNs 2D001 and 2D002 for software for items controlled under this entry. (3) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (4) Also see ECCNs 2B201, 2B290, and 2B991.
Related Definitions: N/A
Items:

Note 1: *2B001 does not control special purpose machine tools limited to the manufacture of gears. For such machines, see 2B003.*

Note 2: *2B001 does not control special purpose machine tools limited to the manufacture of any of the following:*

a. Crank shafts or cam shafts;

b. Tools or cutters;

c. Extruder worms; or

d. Engraved or faceted jewellery parts.

Note 3: *A machine tool having at least two of the three turning, milling or grinding capabilities (e.g., a turning machine with milling capability),*

must be evaluated against each applicable entry 2B001.a., b. or c.

a. Machine tools for turning having all of the following:

a.1. Positioning accuracy according to ISO 230/2 (2006) with "all compensations available" equal to or less (better) than 4.5 µm along one or more linear axis; *and*

a.2. Two or more axes which can be coordinated simultaneously for "contouring control";

Note: *2B001.a does not control turning machines specially designed for producing contact lenses*, *having all of the following:*

a. Machine controller limited to using ophthalmic based software for part programming data input; and

b. No vacuum chucking.

b. Machine tools for milling having any of the following:

b.1. Having all of the following:

b.1.a. Positioning accuracy according to ISO 230/2 (2006) with "all compensations available" of less (better) than 4.5 µm along one or more linear axis; *and*

b.1.b. Three linear axes plus one rotary axis which can be coordinated simultaneously for "contouring control";

b.2. Five or more axes which can be coordinated simultaneously for "contouring control";

b.3. A positioning accuracy according to ISO 230/2 (2006) for jig boring machines, with "all compensations available", of less (better) than 3.0 µm along any linear axis; *or*

b.4. Fly cutting machines having all of the following:

b.4.a. Spindle "run-out" and "camming" less (better) than 0.0004 mm TIR; *and*

b.4.b. Angular deviation of slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over 300 mm of travel.

c. Machine tools for grinding having any of the following:

c.1. Having all of the following:

c.1.a. Positioning accuracy according to ISO 230/2 (2006) with "all compensations available" of less (better) than 3.0 µm along one or more linear axis; *and*

c.1.b. Three or more axes which can be coordinated simultaneously for "contouring control"; or

c.2. Five or more axes which can be coordinated simultaneously for "contouring control";

Notes: *2B001.c does not control grinding machines as follows:*

a. Cylindrical external, internal, and external-internal grinding machines, having all of the following:

a.1. Limited to cylindrical grinding; and

a.2. Limited to a maximum workpiece capacity of 150 mm outside diameter or length.

b. Machines designed specifically as jig grinders that do not have a z-axis or a w-axis, with a positioning accuracy according to ISO 230/2 (2006) with "all compensations available" less (better) than 3 µm.

c. Surface grinders.

d. Electrical discharge machines (EDM) of the non-wire type which have two or more rotary axes which can be coordinated simultaneously for "contouring control";

e. Machine tools for removing metals, ceramics or "composites", having all of the following:

e.1. Removing material by means of any of the following:

e.1.a. Water or other liquid jets, including those employing abrasive additives;

e.1.b. Electron beam; or

e.1.c. "Laser" beam; and

e.2. At least two rotary axes having all of the following:

e.2.a. Can be coordinated simultaneously for "contouring control"; and

e.2.b. A positioning accuracy of less (better) than 0.003°;

f. Deep-hole-drilling machines and turning machines modified for deep-hole-drilling, having a maximum depth-of-bore capability exceeding 5 m and specially designed components therefor.

2B002 Numerically controlled optical finishing machine tools equipped for selective material removal to produce non-spherical optical surfaces having all of the following characteristics (See List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: See also 2B001.
Related Definitions: For the purposes of 2B002, 'MRF' is a material removal process using an abrasive magnetic fluid whose viscosity is controlled by a magnetic field. 'ERF' is a removal process using an abrasive fluid whose viscosity is controlled by an electric field. 'Energetic particle beam finishing' uses Reactive Atom Plasmas (RAP) or ion-beams to selectively remove material. 'Inflatable membrane tool finishing' is a process that uses a pressurized membrane that deforms to contact the workpiece over a small area. 'Fluid jet finishing' makes use of a fluid stream for material removal.
Items:

a. Finishing the form to less (better) than 1.0 μm;

b. Finishing to a roughness less (better) than 100 nm rms;

c. Four or more axes which can be coordinated simultaneously for "contouring control"; *and*

d. Using any of the following processes;

d.1. 'Magnetorheological finishing (MRF)';

d.2. 'Electrorheological finishing (ERF)';

d.3 'Energetic particle beam finishing';

d.4. 'Inflatable membrane tool finishing'; *or*

d.5. 'Fluid jet finishing'.

2B003 "Numerically controlled" or manual machine tools, and specially designed components, controls and accessories therefor, specially designed for the shaving, finishing, grinding or honing of hardened (R_c = 40 or more) spur, helical and double-helical gears with a pitch diameter exceeding 1,250 mm and a face width of 15% of pitch diameter or larger finished to a quality of AGMA 14 or better (equivalent to ISO 1328 class 3).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

License Requirement Notes: *See §743.1 of the EAR for reporting requirements for exports under License Exceptions.*

License Exceptions

LVS: $5000
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Machine Tools in number; components, controls and accessories in $ value
Related Controls: See also 2B993
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2B004 Hot "isostatic presses" having all of the characteristics described in the List of Items Controlled, and specially designed components and accessories therefor.

License Requirements

Reason for Control: NS, MT NP, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
MT applies to entire entry	MT Column 1
NP applies to entire entry, except 2B004.b.3 and presses with maximum working pressures below 69 MPa	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Presses in number; components and accessories in $ value
Related Controls: (1) See ECCN 2D001 for software for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E101 ("use") for technology for items controlled under this entry. (3) For specially designed dies, molds and tooling, see ECCNs 1B003, 2B018, 9B004, and 9B009. (4) For additional controls on dies, molds and tooling, see ECCNs 1B101.d, 2B104 and 2B204. (5) Also see ECCNs 2B117 and 2B999.a.
Related Definitions: N/A
Items:

a. A controlled thermal environment within the closed cavity and possessing a chamber cavity with an inside diameter of 406 mm or more; *and*

b. Having any of the following:

b.1. A maximum working pressure exceeding 207 MPa;

b.2. A controlled thermal environment exceeding 1,773 K (1,500 °C); *or*

b.3. A facility for hydrocarbon impregnation and removal of resultant gaseous degradation products.

Technical Note: *The inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated furnace chamber, depending on which of the two chambers is located inside the other.*

2B005 Equipment specially designed for the deposition, processing and in-process control of inorganic overlays, coatings and surface modifications, as follows, for non-electronic substrates, by processes shown in the Table and associated Notes following 2E003.f, and specially designed automated handling, positioning, manipulation and control components therefor.

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: $1000
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) This entry does not control chemical vapor deposition, cathodic arc, sputter deposition, ion plating or ion implantation equipment, specially designed for cutting or machining tools. (2) Vapor deposition equipment for the production of filamentary materials are controlled by 1B001 or 1B101. (3) Chemical Vapor Deposition furnaces designed or modified for densification of carbon-carbon composites are controlled by 2B105. (4) See also 2B999.i.
Related Definitions: N/A
Items:

a. Chemical vapor deposition (CVD) production equipment having all of the following:

a.1. A process modified for one of the following:

a.1.a. Pulsating CVD;

a.1.b. Controlled nucleation thermal deposition (CNTD); *or*

a.1.c. Plasma enhanced or plasma assisted CVD; *and*

a.2. Having any of the following:

a.2.a. Incorporating high vacuum (equal to or less than 0.01 Pa) rotating seals; *or*

a.2.b. Incorporating in situ coating thickness control;

b. Ion implantation production equipment having beam currents of 5 mA or more;

c. Electron beam physical vapor deposition (EB-PVD) production equipment incorporating power systems rated for over 80 kW and having any of the following:

c.1. A liquid pool level "laser" control system which regulates precisely the ingots feed rate; *or*

c.2. A computer controlled rate monitor operating on the principle of photo-luminescence of the ionized atoms in the evaporant stream to control the deposition rate of a coating containing two or more elements;

d. Plasma spraying production equipment having any of the following:

d.1. Operating at reduced pressure controlled atmosphere (equal or less than 10 kPa measured above and within 300 mm of the gun nozzle exit) in a vacuum chamber capable of evacuation down to 0.01 Pa prior to the spraying process; *or*

d.2. Incorporating in situ coating thickness control;

e. Sputter deposition production equipment capable of current densities of 0.1 mA/mm^2 or higher at a deposition rate 15 µm/h or more;

f. Cathodic arc deposition production equipment incorporating a grid of electromagnets for steering control of the arc spot on the cathode;

g. Ion plating production equipment capable of in situ measurement of any of the following:

g.1. Coating thickness on the substrate and rate control; *or*

g.2. Optical characteristics.

2B006 Dimensional inspection or measuring systems, equipment, and "electronic assemblies", as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
NP applies to 2B006.a and .b, except 2B006.b.1.d	NP Column 1

Note: *NP applies to measuring systems in 2B006.b.1.c that maintain, for at least 12 hours, over a temperature range of ± 1 K around a standard temperature and at a standard pressure, all of the following: a "resolution" over their full scale of 0.1 µm or less (better); and a "measurement uncertainty" equal to or less (better) than (0.2 + L/2,000) µm (L is the measured length in mm).*

AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number, electronic assemblies in $ value
Related Controls: (1) See ECCNs 2D001 and 2D002 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B206 and 2B996.
Related Definitions: N/A
Items:

a. Computer controlled or "numerically controlled" Coordinate Measuring Machines (CMM), having a three dimensional length (volumetric) maximum permissible error of length measurement ($E_{0,MPE}$) at any point within the operating range of the machine (*i.e.*, within the length of axes) equal to or less (better) than (1.7 + L/1,000) μm (L is the measured length in mm) according to ISO 10360-2 (2009);

Technical Note: *The $E_{0,MPE}$ of the most accurate configuration of the CMM specified by the manufacturer (e.g., best of the following: Probe, stylus length, motion parameters, environment) and with "all compensations available" shall be compared to the 1.7 + L/1,000 μm threshold.*

b. Linear and angular displacement measuring instruments, as follows:

b.1. 'Linear displacement' measuring instruments having any of the following:

Technical Note: *For the purpose of 2B006.b.1 'linear displacement' means the change of distance between the measuring probe and the measured object.*

b.1.a. Non-contact type measuring systems with a "resolution" equal to or less (better) than 0.2 μm within a measuring range up to 0.2 mm;

b.1.b. Linear voltage differential transformer systems having all of the following:

b.1.b.1. "Linearity" equal to or less (better) than 0.1% within a measuring range up to 5 mm; *and*

b.1.b.2. Drift equal to or less (better) than 0.1% per day at a standard ambient test room temperature ± 1 K;

b.1.c. Measuring systems having all of the following:

b.1.c.1. Containing a "laser"; *and*

b.1.c.2. Maintaining, for at least 12 hours, at a temperature of 20 ± 1ºC, all of the following:

b.1.c.2.a. A "resolution" over their full scale of 0.1 μm or less (better); *and*

b.1.c.2.b. Capable of achieving a "measurement uncertainty", when compensated for the refractive index of air, equal to or less (better) than (0.2 + L/2,000) μm (L is the measured length in mm); or

b.1.d. "Electronic assemblies" specially designed to provide feedback capability in systems controlled by 2B006.b.1.c;

Note: *2B006.b.1 does not control measuring interferometer systems, with an automatic control system that is designed to use no feedback techniques, containing a "laser" to measure slide movement errors of machine-tools, dimensional inspection machines or similar equipment.*

b.2. Angular displacement measuring instruments having an "angular position deviation" equal to or less (better) than 0.00025°;

Note: *2B006.b.2 does not control optical instruments, such as autocollimators, using collimated light (e.g., laser light) to detect angular displacement of a mirror.*

c. Equipment for measuring surface irregularities, by measuring optical scatter as a function of angle, with a sensitivity of 0.5 nm or less (better).

Note: *2B006 includes machine tools, other than those specified by **2B001**, that can be used as measuring machines, if they meet or exceed the criteria specified for the measuring machine function.*

2B007 "Robots" having any of the following characteristics described in the List of Items Controlled and specially designed controllers and "end-effectors" therefor.

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
NP applies to equipment that meets or exceeds the criteria in ECCNs 2B207	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: $5000, except 2B007.b and .c
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCN 2D001 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B207, 2B225 and 2B997.
Related Definitions: N/A
Items:

a. Capable in real time of full three-dimensional image processing or full three-dimensional 'scene analysis' to generate or modify "programs" or to generate or modify numerical program data;

Technical Note: *The 'scene analysis' limitation does not include approximation of the third dimension by viewing at a given angle, or limited grey scale interpretation for the perception of depth or texture for the approved tasks (2 ½ D).*

b. Specially designed to comply with national safety standards applicable to potentially explosive munitions environments;

Note*: 2B007.b does not apply to "robots" specially designed for paint-spraying booths.*

c. Specially designed or rated as radiation-hardened to withstand a total radiation dose greater than 5×10^3 Gy (silicon) without operational degradation; *or*

Technical Note: *The term Gy (silicon) refers to the energy in Joules per kilogram absorbed by an unshielded silicon sample when exposed to ionizing radiation.*

d. Specially designed to operate at altitudes exceeding 30,000 m.

2B008 Assemblies or units, specially designed for machine tools, or dimensional inspection or measuring systems and equipment, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See also 2B998
Related Definition: N/A
Items:

a. Linear position feedback units having an overall "accuracy" less (better) than (800 + (600 x L x 10^{-3})) nm (L equals the effective length in mm);

N.B.: *For "laser" systems see also 2B006.b.1.*c and d.

b. Rotary position feedback units having an "accuracy" less (better) than 0.00025°;

N.B.: *For "laser" systems see also 2B006.b.2.*

Note: *2B008.a and 2B008.b apply to units, which are designed to determine the positioning information for feedback control, such as inductive type devices, graduated scales, infrared systems or "laser" systems.*

c. "Compound rotary tables" and "tilting spindles", capable of upgrading, according to the manufacturer's specifications, machine tools to or above the levels controlled by 2B001 to 2B009.

2B009 Spin-forming machines and flow-forming machines, which, according to the manufacturer's technical specifications, can be equipped with "numerical control" units or a computer control and having all of the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NS, MT, NP, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 2
MT applies to: spin-forming machines combining the functions of spin-forming and flow-forming; and flow-forming machines that meet or exceed the parameters of 2B009.a and 2B109.	MT Column 1
NP applies to flow-forming machines, and spin-forming machines capable of flow-forming functions, that meet or exceed the parameters of 2B209	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCN 2D001 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E101 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B109 and 2B209 for additional flow-forming machines for MT and NP reasons.
Related Definitions: N/A
Items:

a. Three or more axes which can be coordinated simultaneously for "contouring control"; *and*

b. A roller force more than 60 kN.

Technical Note*: For the purpose of 2B009, machines combining the function of spin-forming and flow-forming are regarded as flow-forming machines.*

2B018 Equipment on the Wassenaar Arrangement Munitions List.

License Requirements

Reason for Control: NS, MT, RS, AT, UN

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 1
MT applies to specialized machinery, equipment, and gear for producing rocket systems (including ballistic missile systems, space launch vehicles, and sounding rockets) and unmanned air vehicle systems (including cruise missile systems, target drones, and reconnaissance drones) usable in systems that are controlled for MT reasons including their propulsion systems and components, and pyrolytic deposition and densification equipment.	MT Column 1
RS applies to entire entry	RS Column 2
AT applies to entire entry	AT Column 1
UN applies to entire entry	See § 746.1(b) for UN controls.

License Exceptions

LVS: $3000

GBS: Yes, as follows, except N/A for MT-controlled items or destinations for which a license is required for RS reasons: Equipment used to determine the safety data of explosives as required by the International Convention on the Transport of Dangerous Goods (C.I.M.) Articles 3 and 4 in Annex 1 RID, provided that such equipment will be used only by the railway authorities of current C.I.M. members, or by the Government-accredited testing facilities in those countries, for the testing of explosives to transport safety standards, of the following description:

a. Equipment for determining the ignition and deflagration temperatures;

b. Equipment for steel-shell tests;

c. Drophammers not exceeding 20 kg in weight for determining the sensitivity of explosives to shock;

d. Equipment for determining the friction sensitivity of explosives when exposed to charges not exceed 36 kg in weight.

CIV: N/A

List of Items Controlled

Unit: Equipment in number; parts and accessories in $ value
Related Controls: N/A
Related Definitions: N/A
Items:

Specialized machinery, equipment, gear, and specially designed parts and accessories therefor, including but not limited to the following, that are specially designed for the examination, manufacture, testing, and checking of arms, appliances, machines, and implements of war:

a. Armor plate drilling machines, other than radial drilling machines;

b. Armor plate planing machines;

c. Armor plate quenching presses;

d. Centrifugal casting machines capable of casting tubes 6 feet (183 cm) or more in length, with a wall thickness of 2 inches (5 cm) and over;

e. Gun barrel rifling and broaching machines, and tools therefor;

f. Gun barrel rifling machines;

g. Gun barrel trepanning machines;

h. Gun boring and turning machines;

i. Gun honing machines of 6 feet (183 cm) stroke or more;

j. Gun jump screw lathes;

k. Gun rifling machines;

l. Gun straightening presses;

m. Induction hardening machines for tank turret rings and sprockets;

n. Jigs and fixtures and other metal-working implements or accessories of the kinds exclusively designed for use in the manufacture of firearms, ordnance, and other stores and appliances for land, sea, or aerial warfare;

o. Small arms chambering machines;

p. Small arms deep hole drilling machines and drills therefor;

q. Small arms rifling machines;

r. Small arms spill boring machines;

s. Tank turret bearing grinding machines.

2B104 "Isostatic presses", other than those controlled by 2B004, having all of the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: MT, NP, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: (1) See ECCN 2D101 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E101 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B004, 2B204, and 2B117.
Related Definitions: The inside chamber dimension is that of the chamber in which both the working temperature and the working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated chamber, depending on which of the two chambers is located inside the other.
Items:

a. Maximum working pressure equal to or greater than 69 MPa;

b. Designed to achieve and maintain a controlled thermal environment of 873 K (600 °C) or greater; *and*

c. Possessing a chamber cavity with an inside diameter of 254 mm or greater.

2B105 Chemical vapor deposition (CVD) furnaces, other than those controlled by 2B005.a, designed or modified for the densification of carbon-carbon composites.

License Requirements

Reason for Control: MT, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: (1) See ECCN 2D101 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E101 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B005 and 2B117.
Related Definitions: N/A
Items:

The list of items controlled in contained in the ECCN heading.

2B109 Flow-forming machines, other than those controlled by 2B009, and specially designed components therefor.

License Requirements

Reason for Control: MT, NP, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
NP applies to items controlled by this entry that meet or exceed the technical parameters in 2B209	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number; components in $ value
Related Controls: (1) See ECCN 2D101 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E101 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B009 and 2B209.
Related Definitions: N/A
Items:

a. Flow-forming machines having all of the following:

a.1. According to the manufacturer's technical specification, can be equipped with "numerical control" units or a computer control, even when not equipped with such units at delivery; *and*

a.2. Have more than two axes which can be coordinated simultaneously for "contouring control."

b. Specially designed components for flow-forming machines controlled in 2B009 or 2B109.a.

Technical Notes:

1. Machines combining the function of spin-forming and flow-forming are for the purpose of 2B109 regarded as flow-forming machines.

2. 2B109 does not control machines that are not usable in the "production" of propulsion components and equipment (e.g., motor cases) for systems in 9A005, 9A007.a, or 9A105.a.

2B116 Vibration test systems and equipment, usable for rockets, missiles, or unmanned aerial vehicles capable of achieving a "range" equal to or greater than 300 km and their subsystems, and components therefor, as follows (see List of Items Controlled).

License Requirements

Reason for Control: MT, NP, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
NP applies to electrodynamic vibration test systems in 2B116.a and to all items in 2B116.b, .c, and .d	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value

Related Controls: (1) See ECCN 2D101 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E101 ("use") for technology for items controlled under this entry. (3) Also see ECCN 9B990.
Related Definitions: Vibration test systems incorporating a digital controller are those systems, the functions of which are, partly or entirely, automatically controlled by stored and digitally coded electrical signals.
Items:

a. Vibration test systems employing feedback or closed loop techniques and incorporating a digital controller, capable of vibrating a system at an acceleration equal to or greater than 10 g rms between 20 Hz to 2,000 Hz while imparting forces equal to or greater than 50 kN (11,250 lbs.), measured 'bare table';

b. Digital controllers, combined with specially designed vibration test "software", with a 'real-time control bandwidth' greater than 5 kHz and designed for use with vibration test systems described in 2B116.a;

c. Vibration thrusters (shaker units), with or without associated amplifiers, capable of imparting a force equal to or greater than 50 kN (11,250 lbs.), measured 'bare table', and usable in vibration test systems described in 2B116.a;

d. Test piece support structures and electronic units designed to combine multiple shaker units into a complete shaker system capable of providing an effective combined force equal to or greater than 50 kN, measured 'bare table', and usable in vibration test systems described in 2B116.a.

Technical Notes*:*

(1) 'Bare table' means a flat table, or surface, with no fixture or fitting.

(2) 'Real-time control bandwidth' is defined

as the maximum rate at which a controller can execute complete cycles of sampling, processing data and transmitting control signals.

2B117 Equipment and process controls, other than those controlled by 2B004, 2B005.a, 2B104 or 2B105, designed or modified for the densification and pyrolysis of structural composite rocket nozzles and reentry vehicle nose tips.

License Requirements

Reason for Control: MT, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: (1) See ECCN 2D101 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E101 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B004, 2B005, 2B104, 2B105, and 2B204.
Related Definitions: N/A
Items:

The list of items controlled in contained in the ECCN heading.

2B119 Balancing machines and related equipment, as follows (see List of Items Controlled).

License Requirements:

Reason for Control: MT, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

License Exceptions:

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled:

Unit: $ value
Related Controls: See also 7B101.
Related Definitions: N/A
Items:

a. Balancing machines having all the following characteristics:

a.1. Not capable of balancing rotors/assemblies having a mass greater than 3 kg;

a.2. Capable of balancing rotors/assemblies at speeds greater than 12,500 rpm;

a.3. Capable of correcting unbalance in two planes or more; and

a.4. Capable of balancing to a residual specific unbalance of 0.2 g mm per kg of rotor mass.

***Note**: 2B119.a. does not control balancing machines designed or modified for dental or other medical equipment.*

b. Indicator heads designed or modified for use with machines specified in 2B119.a.

***Note**: Indicator heads are sometimes known as balancing instrumentation.*

2B120 Motion simulators or rate tables (equipment capable of simulating motion), having all of the following characteristics (see List of Items Controlled).

License Requirements:

Reason for Control: MT, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

License Exceptions:

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled:

Unit: $ value
Related Controls: (1) Rate tables not controlled by 2B120 and providing the characteristics of a positioning table are to be evaluated according to 2B121. (2) Equipment that has the characteristics specified in 2B121, which also meets the characteristics of 2B120 will be treated as equipment specified in 2B120. (3) See also 2B008, 2B121, 7B101 and 7B994.
Related Definitions: N/A
Items:

a. Two axes or more;

b. Designed or modified to incorporate sliprings or integrated non-contact devices capable of transferring electrical power, signal information, or both; *and*

c. Having any of the following characteristics:

c.1. For any single axis having all of the following:

c.1.a. Capable of rates of rotation of 400 degrees/s or more, or 30 degrees/s or less, *and*

c.1.b. A rate resolution equal to or less than 6 degrees/s and an accuracy equal to or less than 0.6 degrees/s; or

c.2. Having a worst-case rate stability equal to or better (less) than plus or minus 0.05% averaged over 10 degrees or more; *or*

c.3. A positioning "accuracy" equal to or better than 5 arc-second.

***Note**: 2B120 does not control rotary tables designed or modified for machine tools or for medical equipment. For controls on machine tool rotary tables see 2B008.*

2B121 Positioning tables (equipment capable of precise rotary position in any axis), other than those controlled in 2B120, having all the following characteristics (See List of Items Controlled).

License Requirements:

Reason for Control: MT, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

License Exceptions:

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled:

Unit: $ value
Related Controls: (1) Equipment that has the characteristics specified in 2B121, which also meets the characteristics of 2B120 will be treated as equipment specified in 2B120. (2) See also 2B008, 2B120, 7B101 and 7B994.
Related Definitions: N/A
Items:

a. Two axes or more; *and*

b. A positioning "accuracy" equal to or better than 5 arc-second.

***Note**: 2B121 does not control rotary tables designed or modified for machine tools or for medical equipment. For controls on machine tool rotary tables see 2B008.*

2B122 Centrifuges capable of imparting accelerations above 100 g and designed or modified to incorporate sliprings or integrated non-contact devices capable of transferring electrical power, signal information, or both.

License Requirements:

Reason for Control: MT, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
AT applies to entire entry	AT Column 1

License Exceptions:

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See also 7B101.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2B201 Machine tools, other than those controlled by 2B001, for removing or cutting metals, ceramics or "composites", which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number; parts and accessories in $ value
Related Controls: (1) See ECCNs 2D002 and 2D202 for "software" for items controlled by this entry. "Numerical control" units are controlled by their associated "software". (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B001, 2B290, and 2B991.
Related Definitions: N/A
Items:

Note: *The identified positioning accuracy values in this entry are based on ISO 230/2(2006), which equates to the values based on ISO 230/2 (1988) that are used by the Nuclear Supplier's Group (NSG). For 2B201.a and b.1, this results in a change from 6 μm to 4.5 μm, in Note to 2B201.b paragraph .b the change is 30 μm to 22.5 μm, and for 2B201.c the change is from 4 μm to 3 μm.*

a. Machine tools for turning, that have positioning accuracies according to ISO 230/2 (2006) with all compensations available better (less) than 4.5 μm along any linear axis (overall positioning) for machines capable of machining diameters greater than 35 mm;

Note: *Item 2B201.a. does not control bar machines (Swissturn), limited to machining only bar feed thru, if maximum bar diameter is equal to or less than 42 mm and there is no capability of mounting chucks. Machines may have drilling and/or milling capabilities for machining parts with diameters less than 42 mm.*

b. Machine tools for milling, having any of the following characteristics:

b.1. Positioning accuracies according to ISO 230/2 (2006) with "all compensations available" equal to or less (better) than 4.5 μm along any linear axis (overall positioning); *or*

b.2. Two or more contouring rotary axes.

Note: *2B201.b does not control milling machines having the following characteristics:*

a. X-axis travel greater than 2 m; and

b. Overall positioning accuracy according to ISO 230/2 (2006) *on the x-axis more (worse) than 22.5 μm.*

c. Machine tools for grinding, having any of the following characteristics:

c.1. Positioning accuracies according to ISO 230/2 (2006) with "all compensations available" equal to or less (better) than 3 μm along any linear axis (overall positioning); *or*

c.2. Two or more contouring rotary axes.

Note: *2B201.c does not control the following grinding machines:*

a. Cylindrical external, internal, and external-internal grinding machines having all of the following characteristics:

1. Limited to cylindrical grinding;

2. A maximum workpiece outside diameter or length of 150 mm;

3. Not more than two axes that can be coordinated simultaneously for "contouring control"; and

4. No contouring c-axis.

b. Jig grinders with axes limited to x, y, c and a where c axis is used to maintain the grinding wheel normal to the work surface, and the a axis is configured to grind barrel cams;

c. Tool or cutter grinding machines with "software" specially designed for the production of tools or cutters; or

d. Crankshaft or camshaft grinding machines.

2B204 "Isostatic presses", other than those controlled by 2B004 or 2B104, and related equipment, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s) *Country Chart*

NP applies to entire entry NP Column 1

AT applies to entire entry AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: (1) See ECCN 2D201 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B004 and 2B104.
Related Definitions: The inside chamber dimension is that of the chamber in which both the working temperature and working pressure are achieved and does not include fixtures. That dimension will be the smaller of either the inside diameter of the pressure chamber or the inside diameter of the insulated chamber, depending on which of the two chambers is located inside the other.
Items:

a. "Isostatic presses" having both of the following characteristics:

a.1. Capable of achieving a maximum working pressure of 69 MPa or greater; *and*

a.2. A chamber cavity with an inside diameter in excess of 152 mm;

b. Dies, molds and controls, specially designed for "isostatic presses" controlled by 2B204.a.

2B206 Dimensional inspection machines, instruments or systems, other than those described in 2B006, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number; parts and accessories in $ value
Related Controls: (1) See ECCNs 2D002 and 2D201 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B006 and 2B996.
Related Definitions: N/A
ECCN Controls: (1) Machine tools that can be used as measuring machines are controlled by this entry if they meet or exceed the criteria specified for the machine tool function or the measuring machine function. (2) A machine described in this entry is controlled if it exceeds the control threshold anywhere within its operating range.
Items:

a. Computer controlled or numerically controlled dimensional inspection machines having both of the following characteristics:

a.1. Two or more axes; *and*

a.2. A one-dimensional length "measurement uncertainty" equal to or less (better) than (1.25 + L/1000) µm tested with a probe of an "accuracy" of less (better) than 0.2 µm (L is the measured length in millimeters) (Ref.: VDI/VDE 2617 Parts 1 and 2);

b. Systems for simultaneously linear-angular inspection of hemishells, having both of the following characteristics:

b.1. "Measurement uncertainty" along any linear axis equal to or less (better) than 3.5 µm per 5 mm; *and*

b.2. "Angular position deviation" equal to or less than 0.02°.

Technical Notes:

(1) The probe used in determining the measurement uncertainty of a dimensional inspection system shall be described in VDI/VDE 2617 parts 2, 3 and 4.

(2) All parameters of measurement values in this entry represent plus/minus, i.e., not total band.

c. Angular displacement measuring instruments having an "angular position deviation" equal to or less (better) than 0.00025°;

Note: *2B206.c does not control optical instruments, such as autocollimators, using collimated light to detect angular displacement of a mirror.*

2B207 "Robots," "end-effectors" and control units, other than those controlled by 2B007, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCN 2D201 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B007, 2B225, and 2B997.
Related Definitions: N/A

ECCN Controls: This entry does not control "robots" specially designed for non-nuclear industrial applications, such as automobile paint-spraying booths.
Items:

a. "Robots" or "end-effectors" specially designed to comply with national safety standards applicable to handling high explosives (for example, meeting electrical code ratings for high explosives);

b. Control units specially designed for any of the "robots" or "end-effectors" controlled by 2B207.a.

2B209 Flow forming machines, spin forming machines capable of flow forming functions, other than those controlled by 2B009 or 2B109, and mandrels, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number; parts and accessories in $ value
Related Controls: (1) See ECCN 2D201 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B009 and 2B109.
Related Definitions: N/A
Items:

a. Machines having both of the following characteristics:

a.1. Three or more rollers (active or guiding); *and*

a.2. According to the manufacturer's technical specifications, can be equipped with "numerical control" units or a computer control;

Note: *2B209.a includes machines that have only a single roller designed to deform metal, plus two auxiliary rollers that support the mandrel, but do not participate directly in the deformation process.*

b. Rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 mm and 400 mm.

2B225 Remote manipulators that can be used to provide remote actions in radiochemical separation operations or hot cells, having either of the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (2) Also see ECCNs 2B007 and 2B207. (3) Remote manipulators specially designed or prepared for use in fuel reprocessing or for use in a reactor are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).
Related Definitions: N/A
Items:

a. A capability of penetrating 0.6 m or more of hot cell wall (through-the-wall operation); *or*

b. A capability of bridging over the top of a hot cell wall with a thickness of 0.6 m or more (over-the-wall operation).

Technical Note: *Remote manipulators provide translation of human operator actions to*

a remote operating arm and terminal fixture. They may be of "master/slave" type or operated by joystick or keypad.

2B226 Controlled atmosphere (vacuum or inert gas) induction furnaces, and power supplies therefor, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (2) Also see ECCN 2B227 and Category 3B.
Related Definitions: N/A
ECCN Controls: 2B226.a does not control furnaces designed for the processing of semiconductor wafers.
Items:

a. Furnaces having all of the following characteristics:

a.1. Capable of operation above 1,123 K (850 °C);

a.2. Induction coils 600 mm or less in diameter; *and*

a.3. Designed for power inputs of 5 kW or more;

b. Power supplies, with a specified power output of 5 kW or more, specially designed for furnaces controlled by 2B226.a.

2B227 Vacuum or other controlled atmosphere metallurgical melting and casting furnaces and related equipment, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCN 2D201 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (2) Also see ECCN 2B226.
Related Definitions: N/A
Items:

a. Arc remelt and casting furnaces having both of the following characteristics:

a.1. Consumable electrode capabilities

between 1,000 cm^3 and 20,000 cm^3; *and*

a.2. Capable of operating with melting temperatures above 1,973 K (1,700 °C);

b. Electron beam melting furnaces and plasma atomization and melting furnaces, having both of the following characteristics:

b.1. A power of 50 kW or greater; *and*

b.2. Capable of operating with melting temperatures above 1,473 K (1,200 °C);

c. Computer control and monitoring systems specially configured for any of the furnaces controlled by 2B227.a or .b.

2B228 Rotor fabrication and assembly equipment, rotor straightening equipment, bellows-forming mandrels and dies, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry.
Related Definitions: N/A
Items:

a. Rotor assembly equipment for assembly of gas centrifuge rotor tube sections, baffles, and end-caps;

Note: *2B228.a includes precision mandrels, clamps, and shrink fit machines.*

b. Rotor straightening equipment for alignment of gas centrifuge rotor tube sections to a common axis;

Technical Note: *The rotor straightening equipment in 2B228.b normally consists of precision measuring probes linked to a computer that subsequently controls the action of, for example, pneumatic rams used for aligning the rotor tube sections.*

c. Bellows-forming mandrels and dies for producing single-convolution bellows.

Technical Note: *In 2B228.c, the bellows have all of the following characteristics:*

1. Inside diameter between 75 mm and 400 mm;

2. Length equal to or greater than 12.7 mm;

3. Single convolution depth greater than 2 mm; and

4. Made of high-strength aluminum alloys, maraging steel or high strength "fibrous or filamentary materials".

2B229 Centrifugal multiplane balancing machines, fixed or portable, horizontal or vertical, as follows (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCN 2D201 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry.
Related Definitions: N/A
Items:

a. Centrifugal balancing machines designed for balancing flexible rotors having a length of 600 mm or more and having all of the following characteristics:

a.1. Swing or journal diameter greater than 75 mm;

a.2. Mass capability of from 0.9 to 23 kg; *and*

a.3. Capable of balancing speed of revolution greater than 5,000 r.p.m.;

b. Centrifugal balancing machines designed for balancing hollow cylindrical rotor components and having all of the following characteristics:

b.1. Journal diameter greater than 75 mm;

b.2. Mass capability of from 0.9 to 23 kg;

b.3. Capable of balancing to a residual imbalance equal to or less than 0.01 kg x mm/kg per plane; *and*

b.4. Belt drive type.

2B230 "Pressure transducers" capable of measuring absolute pressures at any point in the range 0 to 13 kPa and having both of the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry.
Related Definitions: (1) Pressure transducers are devices that convert pressure measurements into an electrical signal. (2) For purposes of this entry, "accuracy" includes non-linearity, hysteresis and repeatability at ambient temperature.
Items:

a. Pressure sensing elements made of or protected by aluminum, aluminum alloy, nickel or nickel alloy with more than 60% nickel by weight; *and*

b. Having either of the following characteristics:

b.1. A full scale of less than 13 kPa and an "accuracy" of better than ± 1% of full-scale; *or*

b.2. A full scale of 13 kPa or greater and an "accuracy" of better than ± 130 Pa.

2B231 Vacuum pumps having all of the following characteristics (see List of Items Controlled).

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry. (2) Vacuum pumps specially designed or prepared for the separation of uranium isotopes are subject to the export licensing authority of the Nuclear Regulatory Commission (see 10 CFR part 110).
Related Definitions: (1) The pumping speed is determined at the measurement point with nitrogen gas or air. (2) The ultimate vacuum is determined at the input of the pump with the input of the pump blocked off.
Items:

a. Input throat size equal to or greater than 380 mm;

b. Pumping speed equal to or greater than 15 m^3/s; *and*

c. Capable of producing an ultimate vacuum better than 13.3 mPa.

2B232 Multistage light gas guns or other high-velocity gun systems (coil, electromagnetic, and electrothermal types, and other advanced systems) capable of accelerating projectiles to 2 km/s or greater.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E201 ("use") for technology for items controlled under this entry.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2B290 "Numerically controlled" machine tools not controlled by 2B001 or 2B201.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number; parts and accessories in $ value
Related Controls: (1) See ECCNs 2D002 and 2D290 for "software" for items controlled under this entry. (2) See ECCNs 2E001 ("development"), 2E002 ("production"), and 2E290 ("use") for technology for items controlled under this entry. (3) Also see ECCNs 2B001, 2B201, and 2B991.
Related Definition: N/A
Items:

a. Turning machines or combination turning/milling machines that are capable of machining diameters greater than 2.5 meters.

b. [RESERVED].

2B350 Chemical manufacturing facilities and equipment, except valves controlled by 2A226 or 2A292, as follows (see List of Items Controlled).

License Requirements

Reason for Control: CB, AT

Control(s)	*Country Chart*
CB applies to entire entry	CB Column 2
AT applies to entire entry	AT Column 1

License Requirement Note: *This ECCN does not control equipment that is both: (1) specially designed for use in civil applications (e.g., food processing, pulp and paper processing, or water purification) and (2) inappropriate, by the nature of its design, for use in storing, processing, producing or conducting and controlling the flow of the chemical weapons precursors controlled by 1C350.*

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: N/A
Related Definitions: For purposes of this entry the term "chemical warfare agents" are those agents subject to the export licensing authority of the U.S. Department of State, Directorate of Defense Trade Controls. (See 22 CFR part 121)
Items:

a. Reaction vessels or reactors, with or without agitators, with total internal (geometric) volume greater than 0.1 m^3 (100 liters) and less than 20 m^3 (20,000 liters), where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

a.1. Alloys with more than 25% nickel and 20% chromium by weight;

a.2. Nickel or alloys with more than 40% nickel by weight;

a.3. Fluoropolymers (polymeric or elastomeric materials with more than 35%

fluorine by weight);

a.4. Glass (including vitrified or enameled coating or glass lining);

a.5. Tantalum or tantalum alloys;

a.6. Titanium or titanium alloys;

a.7. Zirconium or zirconium alloys; *or*

a.8. Niobium (columbium) or niobium alloys.

b. Agitators for use in reaction vessels or reactors described in 2B350.a, and impellers, blades or shafts designed for such agitators, where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

b.1. Alloys with more than 25% nickel and 20% chromium by weight;

b.2. Nickel or alloys with more than 40% nickel by weight;

b.3. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by weight);

b.4. Glass (including vitrified or enameled coatings or glass lining);

b.5. Tantalum or tantalum alloys;

b.6. Titanium or titanium alloys;

b.7. Zirconium or zirconium alloys; *or*

b.8. Niobium (columbium) or niobium alloys.

c. Storage tanks, containers or receivers with a total internal (geometric) volume greater than 0.1 m^3 (100 liters) where all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

c.1. Alloys with more than 25% nickel and 20% chromium by weight;

c2. Nickel or alloys with more than 40% nickel by weight;

c.3. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by weight);

c.4. Glass (including vitrified or enameled coatings or glass lining);

c.5. Tantalum or tantalum alloys;

c.6. Titanium or titanium alloys;

c.7. Zirconium or zirconium alloys; *or*

c.8. Niobium (columbium) or niobium alloys.

d. Heat exchangers or condensers with a heat transfer surface area of less than 20 m^2, but greater than 0.15 m^2, and tubes, plates, coils or blocks (cores) designed for such heat exchangers or condensers, where all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:

d.1. Alloys with more than 25% nickel and 20% chromium by weight;

d.2. Nickel or alloys with more than 40% nickel by weight;

d.3. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by weight);

d.4. Glass (including vitrified or enameled coatings or glass lining);

d.5. Tantalum or tantalum alloys;

d.6. Titanium or titanium alloys;

d.7. Zirconium or zirconium alloys;

d.8. Niobium (columbium) or niobium alloys.

d.9. Graphite or carbon-graphite;

d.10. Silicon carbide; *or*

d.11. Titanium carbide.

e. Distillation or absorption columns of internal diameter greater than 0.1 m, and liquid distributors, vapor distributors or liquid collectors designed for such distillation or absorption columns, where all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:

e.1. Alloys with more than 25% nickel and 20% chromium by weight;

e.2. Nickel or alloys with more than 40% nickel by weight;

e.3. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by weight);

e.4. Glass (including vitrified or enameled coatings or glass lining);

e.5. Tantalum or tantalum alloys;

e.6. Titanium or titanium alloys;

e.7. Zirconium or zirconium alloys;

e.8. Niobium (columbium) or niobium alloys; *or*

e.9. Graphite or carbon-graphite.

f. Remotely operated filling equipment in which all surfaces that come in direct contact with the chemical(s) being processed are made from any of the following materials:

f.1. Alloys with more than 25% nickels and 20% chromium by weight; *or*

f.2. Nickel or alloys with more than 40% nickel by weight.

g. Valves with nominal sizes greater than 1.0 cm (3/8in.), and casings (valve bodies) or preformed casing liners designed for such valves, in which all surfaces that come in direct contact with the chemical(s) being produced, processed, or contained are made from any of the following materials:

g.1. Alloys with more than 25% nickel and 20% chromium by weight;

g.2. Nickel or alloys with more than 40% nickel by weight;

g.3. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by weight);

g.4. Glass (including vitrified or enameled coating or glass lining);

g.5. Tantalum or tantalum alloys;

g.6. Titanium or titanium alloys;

g.7. Zirconium or zirconium alloys;

g.8. Niobium (columbium) or niobium alloys; or

g.9. Ceramic materials, as follows:

g.9.a. Silicon carbide with a purity of 80% or more by weight;

g.9.b. Aluminum oxide (alumina) with a purity of 99.9% or more by weight; or

g.9.c. Zirconium oxide (zirconia).

Technical Note to 2B350.g: *The 'nominal size' is defined as the smaller of the inlet and outlet port diameters*.

h. Multi-walled piping incorporating a leak detection port, in which all surfaces that come in direct contact with the chemical(s) being processed or contained are made from any of the following materials:

h.1. Alloys with more than 25% nickel and 20% chromium by weight;

h.2. Nickel or alloys with more than 40% nickel by weight;

h.3. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by weight);

h.4. Glass (including vitrified or enameled coatings or glass lining);

h.5. Tantalum or tantalum alloys;

h.6. Titanium or titanium alloys;

h.7. Zirconium or zirconium alloys;

h.8. Niobium (columbium) or niobium alloys; *or*

h.9. Graphite or carbon-graphite.

i. Multiple-seal and seal-less pumps with manufacturer's specified maximum flow-rate greater than 0.6 m^3 /hour (600 liters/hour), or vacuum pumps with manufacturer's specified maximum flow-rate greater than 5 m^3 /hour (5000 liters/hour) (under standard temperature (273 K (0 °C)) and pressure (101.3 kPa) conditions), and casings (pump bodies), preformed casing liners, impellers, rotors or jet pump nozzles designed for such pumps, in which all surfaces that come into direct contact with the chemical(s) being processed are made from any of the following materials:

i.1. Alloys with more than 25% nickel and 20% chromium by weight;

i.2. Nickel or alloys with more than 40% nickel by weight;

i.3. Fluoropolymers (polymeric or elastomeric materials with more than 35% fluorine by weight);

i.4. Glass (including vitrified or enameled coatings or glass lining);

i.5. Tantalum or tantalum alloys;

i.6. Titanium or titanium alloys;

i.7. Zirconium or zirconium alloys;

i.8. Niobium (columbium) or niobium alloys.

i.9. Graphite or carbon-graphite;

i.10. Ceramics; *or*

i.11. Ferrosilicon (high silicon iron alloys).

j. Incinerators designed to destroy chemical warfare agents, chemical weapons precursors controlled by 1C350, or chemical munitions having specially designed waste supply systems, special handling facilities and an average combustion chamber temperature greater than 1000° C in which all surfaces in the waste supply system that come into direct contact with the waste products are made from or lined with any of the following materials:

j.1. Alloys with more than 25% nickel and 20% chromium by weight;

j.2. Nickel or alloys with more than 40% nickel by weight; *or*

j.3. Ceramics.

Technical Note 1: *Carbon-graphite is a composition consisting primarily of graphite and amorphous carbon, in which the graphite is 8 percent or more by weight of the composition.*

Technical Note 2: *For the items listed in 2B350, the term 'alloy,' when not accompanied by a specific elemental concentration, is understood as identifying those alloys where the identified metal is present in a higher percentage by weight than any other element.*

Technical Note 3: *The materials used for gaskets, packing, seals, screws or washers, or other materials performing a sealing function, do not determine the control status of the items in this ECCN, provided that such components are designed to be interchangeable.*

2B351 Toxic gas monitoring systems and their dedicated detecting components (i.e., detectors, sensor devices, and replaceable sensor cartridges), as follows, except those systems and detectors controlled by ECCN 1A004.c (see List of Items Controlled).

License Requirements

Reason for Control: CB, AT

Control(s)	*Country Chart*
CB applies to entire entry	CB Column 2
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: See ECCN 2D351 for "software" for toxic gas monitoring systems and their dedicated detecting components controlled by this ECCN. Also see ECCN 1A004, which controls chemical detection systems and specially designed components therefor that are specially designed or modified for detection or identification of chemical warfare agents, but not specially designed for military use, and ECCN 1A995, which controls certain detection equipment and components not controlled by ECCN 1A004 or by this ECCN.

Related Definitions: (1) For the purposes of this entry, the term "*dedicated*" means committed entirely to a single purpose or device. (2) For the purposes of this entry, the term "*continuous operation*" describes the capability of the equipment to operate on line without human intervention. The intent of this entry is to control toxic gas monitoring systems capable of collection and detection of samples in environments such as chemical plants, rather than those used for batch-mode operation in laboratories.
Items:

a. Designed for continuous operation and usable for the detection of chemical warfare agents or chemicals controlled by 1C350 at concentrations of less than 0.3mg/m^3; *or*

b. Designed for the detection of cholinesterase-inhibiting activity.

2B352 Equipment capable of use in handling biological materials, as follows (see List of Items Controlled).

License Requirements

Reason for Control: CB, AT

Control(s)	*Country Chart*
CB applies to entire entry	CB Column 2

AT applies to entire entry AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: See ECCNs 1A004 and 1A995 for protective equipment that is not covered by this entry. Also see ECCN 9A120 for controls on certain "UAV" systems designed or modified to dispense an aerosol and capable of carrying elements of a payload in the form of a particulate or liquid, other than fuel components of such vehicles, of a volume greater than 20 liters.
Related Definitions: (1) "Lighter than air vehicles" – balloons and airships that rely on hot air or on lighter-than-air gases, such as helium or hydrogen, for their lift. (2) "UAVs" – Unmanned Aerial Vehicles. (3) "VMD" – Volume Median Diameter.
Items:

a. Complete containment facilities at P3 or P4 containment level.

Technical Note: *P3 or P4 (BL3, BL4, L3, L4) containment levels are as specified in the WHO Laboratory Biosafety Manual (3rd edition, Geneva, 2004).*

b. Fermenters capable of cultivation of pathogenic microorganisms, viruses, or for toxin production, without the propagation of aerosols, having a capacity equal to or greater than 20 liters.

Technical Note: *Fermenters include bioreactors, chemostats, and continuous-flow systems.*

c. Centrifugal separators capable of the continuous separation of pathogenic microorganisms, without the propagation of aerosols, and having all of the following characteristics:

c.1. One or more sealing joints within the steam containment area;

c.2. A flow rate greater than 100 liters per hour;

c.3. Components of polished stainless steel or titanium; *and*

c.4. Capable of in-situ steam sterilization in a closed state.

Technical Note: *Centrifugal separators include decanters.*

d. Cross (tangential) flow filtration equipment and accessories, as follows:

d.1. Cross (tangential) flow filtration equipment capable of separation of pathogenic microorganisms, viruses, toxins or cell cultures having all of the following characteristics:

d.1.a. A total filtration area equal to or greater than 1 square meter (1 m^2); *and*

d.1.b. Having any of the following characteristics:

d.1.b.1. Capable of being sterilized or disinfected in-situ; *or*

d.1.b.2. Using disposable or single-use filtration components.

N.B.: *2B352.d.1 does not control reverse osmosis equipment, as specified by the manufacturer.*

d.2. Cross (tangential) flow filtration components (e.g., modules, elements, cassettes, cartridges, units or plates) with filtration area equal to or greater than 0.2 square meters (0.2 m^2) for each component and designed for use in cross

(tangential) flow filtration equipment controlled by 2B352.d.1.

Technical Note: *In this ECCN, "sterilized" denotes the elimination of all viable microbes from the equipment through the use of either physical (e.g., steam) or chemical agents. "Disinfected" denotes the destruction of potential microbial infectivity in the equipment through the use of chemical agents with a germicidal effect. "Disinfection" and "sterilization" are distinct from "sanitization", the latter referring to cleaning procedures designed to lower the microbial content of equipment without necessarily achieving elimination of all microbial infectivity or viability.*

e. Steam sterilizable freeze-drying (lyophilization) equipment with a condenser capacity of 10 kgs of ice or greater in 24 hours (10 liters of water or greater in 24 hours), but less than 1,000 kgs of ice in 24 hours (less than 1,000 liters of water in 24 hours).

f. Protective and containment equipment, as follows:

f.1. Protective full or half suits, or hoods dependant upon a tethered external air supply and operating under positive pressure;

Technical Note: *This entry does not control suits designed to be worn with self-contained breathing apparatus.*

f.2. Class III biological safety cabinets or isolators with similar performance standards, e.g., flexible isolators, dry boxes, anaerobic chambers, glove boxes or laminar flow hoods (closed with vertical flow).

g. Chambers designed for aerosol challenge testing with microorganisms, viruses, or toxins and having a capacity of 1 m^3 or greater.

h. Spraying or fogging systems and components therefor, as follows:

h.1. Complete spraying or fogging systems, specially designed or modified for fitting to aircraft, "lighter than air vehicles," or "UAVs," capable of delivering, from a liquid suspension, an initial droplet "VMD" of less than 50 microns at a flow rate of greater than 2 liters per minute;

h.2. Spray booms or arrays of aerosol generating units, specially designed or modified for fitting to aircraft, "lighter than air vehicles," or "UAVs," capable of delivering, from a liquid suspension, an initial droplet "VMD" of less than 50 microns at a flow rate of greater than 2 liters per minute;

h.3. Aerosol generating units specially designed for fitting to the systems specified in paragraphs h.1 and h.2 of this ECCN.

Technical Notes:

1. "Aerosol generating units" are devices specially designed or modified for fitting to aircraft and include nozzles, rotary drum atomizers and similar devices.

2. This ECCN does not control spraying or fogging systems and components, as specified in 2B352.h., that are demonstrated not to be capable of delivering biological agents in the form of infectious aerosols.

3. Droplet size for spray equipment or nozzles specially designed for use on aircraft or "UAVs" should be measured using either of the following methods (pending the adoption of internationally accepted standards):

a. Doppler laser method,

b. Forward laser diffraction method.

2B991 Numerical control units for machine tools and "numerically controlled" machine tools, n.e.s.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: Also see ECCNs 2B001, 2B201, and 2B290.
Related Definitions: N/A
Items:

a. "Numerical control" units for machine tools:

a.1. Having four interpolating axes that can be coordinated simultaneously for "contouring control"; *or*

a.2. Having two or more axes that can be coordinated simultaneously for "contouring control" and a minimum programmable increment better (less) than 0.001 mm;

a.3. "Numerical control" units for machine tools having two, three or four interpolating axes that can be coordinated simultaneously for "contouring control", and capable of receiving directly (on-line) and processing computer-aided-design (CAD) data for internal preparation of machine instructions; *or*

b. "Motion control boards" specially designed for machine tools and having any of the following characteristics:

b.1. Interpolation in more than four axes;

b.2. Capable of "real time processing" of data to modify tool path, feed rate and spindle data, during the machining operation, by any of the following:

b.2.a. Automatic calculation and modification of part program data for machining in two or more axes by means of measuring cycles and access to source data; *or*

b.2.b. "Adaptive control" with more than one physical variable measured and processed by means of a computing model (strategy) to change one or more machining instructions to optimize the process.

b.3. Capable of receiving and processing CAD data for internal preparation of machine instructions; *or*

c. "Numerically controlled" machine tools that, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes and that have both of the following characteristics:

c.1. Two or more axes that can be coordinated simultaneously for contouring control; *and*

c.2. Positioning accuracies according to ISO 230/2 (2006), with all compensations available:

c.2.a. Better than 15 μm along any linear axis (overall positioning) for grinding machines;

c.2.b. Better than 15 μm along any linear axis (overall positioning) for milling machines; *or*

c.2.c. Better than 15 μm along any linear axis (overall positioning) for turning machines; *or*

d. Machine tools, as follows, for removing or cutting metals, ceramics or composites, that, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:

d.1. Machine tools for turning, grinding, milling or any combination thereof, having two or more axes that can be coordinated simultaneously for "contouring control" and having any of the following characteristics:

d.1.a. One or more contouring "tilting spindles";

Note: *2B991.d.1.a. applies to machine tools for grinding or milling only.*

d.1.b. "Camming" (axial displacement) in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

Note: *2B991.d.1.b. applies to machine tools for turning only.*

d.1.c. "Run out" (out-of-true running) in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

d.1.d. The "positioning accuracies", with all compensations available, are less (better) than: 0.001° on any rotary axis;

d.2. Electrical discharge machines (EDM) of the wire feed type that have five or more axes that can be coordinated simultaneously for "contouring control".

2B992 Non-"numerically controlled" machine tools for generating optical quality surfaces, and specially designed components therefor.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: N/A
Related Definitions: N/A
Items:

a. Turning machines using a single point cutting tool and having all of the following characteristics:

a.1. Slide positioning accuracy less (better) than 0.0005 mm per 300 mm of travel;

a.2. Bidirectional slide positioning repeatability less (better) than 0.00025 mm per 300 mm of travel;

a.3. Spindle "run out" and "camming" less (better) than 0.0004 mm total indicator reading (TIR);

a.4. Angular deviation of the slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over full travel; *and*

a.5. Slide perpendicularity less (better) than 0.001 mm per 300 mm of travel;

Technical Note*: The bidirectional slide positioning repeatability (R) of an axis is the maximum value of the repeatability of positioning at any position along or around the axis determined using the procedure and under the conditions specified in part 2.11 of ISO 230/2: 1988.*

b. Fly cutting machines having all of the following characteristics:

b.1. Spindle "run out" and "camming" less (better) than 0.0004 mm TIR; *and*

b.2. Angular deviation of slide movement (yaw, pitch and roll) less (better) than 2 seconds of arc, TIR, over full travel.

2B993 Gearmaking and/or finishing machinery not controlled by 2B003 capable of producing gears to a quality level of better than AGMA 11.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2B996 Dimensional inspection or measuring systems or equipment not controlled by 2B006.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: Equipment in number
Related Controls: N/A
Related Definitions: N/A
Items:

a. Manual dimensional inspection machines, having both of the following characteristics:

a.1. Two or more axes; *and*

a.2. A measurement uncertainty equal to or less (better) than (3 + L/300) micrometer in any axes (L measured length in mm).

2B997 "Robots" not controlled by 2B007 or 2B207 that are capable of employing feedback information in real-time processing from one or more sensors to generate or modify "programs" or to generate or modify numerical program data.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A

CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2B998 Assemblies, units or inserts specially designed for machine tools controlled by 2B991, or for equipment controlled by 2B993, 2B996 or 2B997.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value
Related Controls: This entry does not control measuring interferometer systems, without closed or open loop feedback, containing a laser to measure slide movement errors of machine-tools, dimensional inspection machines or similar equipment.
Related Definition: N/A
Items:

a. Spindle assemblies, consisting of spindles and bearings as a minimal assembly, with radial ("run out") or axial ("camming") axis motion in one revolution of the spindle less (better) than 0.0006 mm total indicator reading (TIR);

b. Single point diamond cutting tool inserts, having all of the following characteristics:

b.1. Flawless and chip-free cutting edge when magnified 400 times in any direction;

b.2. Cutting radius from 0.1 to 5 mm inclusive; *and*

b.3. Cutting radius out-of-roundness less (better) than 0.002 mm TIR.

c. Specially designed printed circuit boards with mounted components capable of upgrading, according to the manufacturer's specifications, "numerical control" units, machine tools or feed-back devices to or above the levels specified in ECCNs 2B991, 2B993, 2B996, 2B997, or 2B998.

2B999 Specific processing equipment, n.e.s., as follows (see List of Items Controlled).

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry. A license is required for items controlled by this entry to North Korea for anti-terrorism reasons. The Commerce Country Chart is not designed to determine AT licensing requirements for this entry. See §742.19 of the EAR for additional information.	

License Exceptions

LVS: N/A
GBS: N/A
CIV: N/A

List of Items Controlled

Unit: $ value

Related Controls: See also 0B001, 0B002, 0B004, 1B233, 2A293, 2B001.f, 2B004, 2B009, 2B104, 2B109, 2B204, 2B209, 2B228, 2B229, 2B231, 2B350.
Related Definitions: N/A
Items:

a. Isostatic presses, n.e.s.;

b. Bellows manufacturing equipment, including hydraulic forming equipment and bellows forming dies;

c. Laser welding machines;

d. MIG welders;

e. E-beam welders;

f. Monel equipment, including valves, piping, tanks and vessels;

g. 304 and 316 stainless steel valves, piping, tanks and vessels;

h. Mining and drilling equipment, as follows:

h.1. Large boring equipment capable of drilling holes greater than two feet in diameter;

h.2. Large earth-moving equipment used in the mining industry;

i. Electroplating equipment designed for coating parts with nickel or aluminum;

j. Pumps designed for industrial service and for use with an electrical motor of 5 HP or greater;

k. Vacuum valves, piping, flanges, gaskets and related equipment specially designed for use in high-vacuum service, n.e.s.;

l. Spin forming and flow forming machines, n.e.s.;

m. Centrifugal multiplane balancing machines, n.e.s.;

n. Austenitic stainless steel plate, valves, piping, tanks and vessels.

C. MATERIALS [RESERVED]

D. SOFTWARE

2D001 "Software", other than that controlled by 2D002, specially designed or modified for the "development", "production" or "use" of equipment controlled by 2A001 or 2B001 to 2B009.

License Requirements

Reason for Control: NS, MT, NP, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 1
MT applies to "software" for equipment controlled by 2B004 and 2B009 for MT reasons	MT Column 1
NP applies to specially designed or modified "software" for equipment controlled by 2B001 for NP reasons, and to specially designed "software" for equipment controlled by 2B004, 2B006, 2B007, or 2B009 for NP reasons	NP Column 1
AT applies to entire entry	AT Column 1

***License Requirement Notes**: See §743.1 of the EAR for reporting requirements for exports under License Exceptions.*

License Exceptions

CIV: N/A
TSR: Yes, except N/A for MT
STA: License Exception STA may not be used to ship or transmit "software", other than that specified by ECCN 2D002, specially designed for the "development" or "production" of equipment as follows: ECCN 2B001 entire entry; or "Numerically controlled" or manual machine tools as specified in 2B003to any of the eight destinations listed in § 740.20(c)(2) of the EAR.

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCNs 2E001 ("development") and 2E101 ("use") for technology for "software" controlled under this entry. (2) Also see ECCNs 2D101 and 2D201.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2D002 "Software" for electronic devices, even when residing in an electronic device or system, enabling such devices or systems to function as a "numerical control" unit, capable of coordinating simultaneously more than 4 axes for "contouring control".

License Requirements

Reason for Control: NS, NP, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 1
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: Yes

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCNs 2E001 ("development") and 2E201 ("use") for technology for "software" controlled under this entry. (2) Also see ECCN 2D202.
Related Definitions: N/A
Items:

Note 1: *2D002 does not control "software" specially designed or modified for the operation of machine tools not controlled by Category 2.*

Note 2: *2D002 does not control "software" for items controlled by 2B002. See 2D001 for control of "software" for items controlled by 2B002.*

The list of items controlled is contained in the ECCN heading.

2D018 "Software" for the "development", "production" or "use" of equipment controlled by 2B018.

License Requirements

Reason for Control: NS, MT, AT, UN

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 1
MT applies to "software" for equipment controlled by 2B018 for MT reasons	MT Column 1
AT applies to entire entry	AT Column 1
UN applies to entire entry	See § 746.1(b) for UN controls.

License Exceptions

CIV: N/A
TSR: Yes.

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2D101 "Software" specially designed or modified for the "use" of equipment controlled by 2B104, 2B105, 2B109, 2B116, 2B117, or 2B119 to 2B122.

License Requirements

Reason for Control: MT, NP, AT

Control(s)	*Country Chart*
MT applies to entire entry	MT Column 1
NP applies to "software" specially designed for the "use" of items controlled by 2B104, 2B109, or 2B116 for NP reasons	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCNs 2E001 ("development") and 2E101 ("use") for technology for "software" controlled under this entry. (2) Also see ECCN 9D004.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2D201 "Software" specially designed for the "use" of equipment controlled by 2B204, 2B206, 2B207, 2B209, 2B227 or 2B229.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) See ECCNs 2E001 ("development") and 2E201 ("use") for technology for "software" controlled under this entry. (2) Also see ECCNs 2D002 and 2D202.
Related Definitions: N/A
ECCN Controls: "Software" specially designed for systems controlled by 2B206.b includes software for simultaneous measurements of wall thickness and contour.
Items:

The list of items controlled is contained in the ECCN heading.

2D202 "Software" specially designed or

modified for the "development", "production" or "use" of equipment controlled by 2B201.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2D290 "Software" specially designed or modified for the "development", "production" or "use" of items controlled by 2A290, 2A291, 2A292, 2A293, or 2B290.

License Requirements

Reason for Control: NP, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: See ECCN 2E001 ("development") for technology for "software" controlled under this entry.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2D351 Dedicated "software" for toxic gas monitoring systems and their dedicated detecting components controlled by ECCN 2B351.

License Requirements

Reason for Control: CB, AT

Control(s)	*Country Chart*
CB applies to entire entry	CB Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: (1) For the purposes of this entry, the term "*dedicated*" means committed entirely to a single purpose or device. (2) See Section 772.1 of the EAR for the definitions of "*software*," "*program*," and "*microprogram*."
Items:

The list of items controlled is contained in the

ECCN heading.

2D983 "Software" specially designed or modified for the "development", "production" or "use" of equipment controlled by 2A983.

License Requirements

Reason for Control: RS, AT

Control(s)	*Country Chart*
RS applies to entire entry	RS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2D984 "Software" "required" for the "development", "production" or "use" of concealed object detection equipment controlled by 2A984.

License Requirements

Reason for Control: RS, AT

Control(s)	*Country Chart*
RS applies to entire entry	RS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) "Software" "required" for the "development", "production" or "use" of concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution less than 0.5 milliradian (a lower milliradian number means a more accurate image resolution) at a standoff distance of 100 meters is under the export licensing authority of the U.S. Department of State (22 CFR parts 120 through 130). (2) "Software" "required" for the "development", "production" or "use" of concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution greater than 1 milliradian spatial resolution (a higher milliradian number means a less accurate image resolution) at a standoff distance of 100 meters is designated as EAR99. (3) See ECCNs 2A984 and 2E984 for related commodity and technology controls.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2D991 "Software" specially designed for the "development", "production", or "use" of equipment controlled by 2B991, 2B993, or 2B996, 2B997, and 2B998.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2D992 Specific "software", as follows (see List of Items Controlled).

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: N/A
Items:

a. "Software" to provide "adaptive control" and having both of the following characteristics:

a.1. For "flexible manufacturing units" (FMUs) which consist at least of equipment described in b.1 and b.2 of the definition of "flexible manufacturing unit" contained in part 772 of the EAR; *and*

a.2. Capable of generating or modifying, in "real time processing", programs or data by using the signals obtained simultaneously by means of at least two detection techniques, such as:

a.2.a. Machine vision (optical ranging);

a.2.b. Infrared imaging;

a.2.c. Acoustical imaging (acoustical ranging);

a.2.d. Tactile measurement;

a.2.e. Inertial positioning;

a.2.f. Force measurement; *and*

a.2.g. Torque measurement.

Note: *2D992.a does not control "software" which only provides rescheduling of functionally identical equipment within "flexible manufacturing units" using pre-stored part programs and a pre-stored strategy for the distribution of the part programs.*

b. [RESERVED].

2D994 "Software" specially designed for the "development" or "production" of portable electric generators controlled by 2A994.

License Requirements

Reason for Control: AT

Control(s)

AT applies to entire entry. A license is required for items controlled by this entry to Cuba, Iran and North Korea for anti terrorism reasons. The Commerce Country Chart is not designed to determine licensing requirements for this entry. See part 746 of the EAR for additional information on Cuba and Iran. See §742.19 of the EAR for additional information on North Korea.

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

E. TECHNOLOGY

2E001 "Technology" according to the General Technology Note for the "development" of equipment or "software" controlled by 2A (except 2A983, 2A984, 2A991, or 2A994), 2B (except 2B991, 2B993, 2B996, 2B997, or 2B998), or 2D (except 2D983, 2D984, 2D991, 2D992, or 2D994).

License Requirements

Reason for Control: NS, MT, NP, CB, AT

Control(s)	*Country Chart*
NS applies to "technology" for items controlled by 2A001, 2B001 to 2B009, 2D001 or 2D002	NS Column 1
MT applies to "technology " for items controlled by 2B004, 2B009, 2B018, 2B104, 2B105, 2B109, 2B116, 2B117, 2B119 to 2B122, 2D001, or 2D101 for MT reasons	MT Column 1
NP applies to "technology" for items controlled by 2A225, 2A226, 2B001, 2B004, 2B006, 2B007, 2B009, 2B104, 2B109, 2B116, 2B201, 2B204, 2B206, 2B207, 2B209, 2B225 to 2B232, 2D001, 2D002, 2D101, 2D201 or 2D202 for NP reasons	NP Column 1
NP applies to "technology" for items controlled by 2A290 to 2A293, 2B290, or 2D290 for NP reasons	NP Column 2
CB applies to "technology" for equipment controlled by 2B350 to 2B352, valves controlled by 2A226 or 2A292 having the characteristics of those controlled by 2B350.g, and software controlled by 2D351	CB Column 2
AT applies to entire entry	AT Column 1

License Requirement Notes: *See §743.1 of the EAR for reporting requirements for exports under License Exceptions.*

License Exceptions

CIV: N/A
TSR: Yes, except N/A for MT
STA: License Exception STA may not be used to ship or transmit "technology" according to the General Technology Note for the "development" of "software" specified in the License Exception STA paragraph in the License Exception section of ECCN 2D001 or for the "development" of equipment as follows: ECCN 2B001 entire entry; or "Numerically controlled" or manual machine tools as specified in 2B003 to any of the eight destinations listed in § 740.20(c)(2) of the EAR.

List of Items Controlled

Unit: N/A
Related Controls: See also 2E101, 2E201, and 2E301
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

Note: *ECCN 2E001 includes "technology" for the integration of probe systems into coordinate measurement machines specified by 2B006.a.*

2E002 "Technology" according to the General Technology Note for the "production" of equipment controlled by 2A (except 2A983, 2A984, 2A991, or 2A994), or 2B (except 2B991, 2B993, 2B996, 2B997, or 2B998).

License Requirements

Reason for Control: NS, MT, NP, CB, AT

Control(s)	*Country Chart*
NS applies to "technology" for equipment controlled by 2A001, 2B001 to 2B009	NS Column 1
MT applies to "technology" for equipment controlled by 2B004, 2B009, 2B018, 2B104, 2B105, 2B109, 2B116, 2B117, or 2B119 to 2B122 for MT reasons	MT Column 1
NP applies to "technology" for equipment controlled by 2A225, 2A226, 2B001, 2B004, 2B006, 2B007, 2B009, 2B104, 2B109, 2B116, 2B201, 2B204, 2B206, 2B207, 2B209, 2B225 to 2B232 for NP reasons	NP Column 1
NP applies to "technology" for equipment controlled by 2A290 to 2A293, 2B290 for NP reasons	NP Column 2
CB applies to "technology" for equipment controlled by 2B350 to 2B352 and for valves controlled by 2A226 or 2A292 having the characteristics of those controlled by 2B350.g	CB Column 2
AT applies to entire entry	AT Column 1

License Requirement Notes: See §743.1 of the EAR for reporting requirements for exports under License Exceptions.

License Exceptions

CIV: N/A
TSR: Yes, except N/A for MT
STA: License Exception STA may not be used to ship or transmit "technology" according to the General Technology Note for the "production" of equipment as follows: ECCN 2B001 entire entry; or "Numerically controlled" or manual machine tools as specified in 2B003to any of the eight destinations listed in § 740.20(c)(2) of the EAR.

List of Items Controlled

Unit: N/A
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2E003 Other "technology", as follows (see List of Items Controlled).

License Requirements

Reason for Control: NS, AT

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 1
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: Yes, except 2E003.a, .b, .e and .f

List of Items Controlled

Unit: N/A
Related Controls: See 2E001, 2E002, and 2E101 for "development" and "use" technology for equipment that are designed or modified for densification of carbon-carbon composites, structural composite rocket nozzles and reentry vehicle nose tips.
Related Definitions: N/A
Items:

a. "Technology" for the "development" of interactive graphics as an integrated part in "numerical control" units for preparation or modification of part programs;

b. "Technology" for metal-working manufacturing processes, as follows:

b.1. "Technology" for the design of tools, dies or fixtures specially designed for any of the following processes:

b.1.a. "Superplastic forming";

b.1.b. "Diffusion bonding"; *or*

b.1.c. "Direct-acting hydraulic pressing";

b.2. Technical data consisting of process methods or parameters as listed below used to control:

b.2.a. "Superplastic forming" of aluminum alloys, titanium alloys or "superalloys":

b.2.a.1. Surface preparation;

b.2.a.2. Strain rate;

b.2.a.3. Temperature;

b.2.a.4. Pressure;

b.2.b. "Diffusion bonding" of "superalloys" or titanium alloys:

b.2.b.1. Surface preparation;

b.2.b.2. Temperature;

b.2.b.3. Pressure;

b.2.c. "Direct-acting hydraulic pressing" of aluminum alloys or titanium alloys:

b.2.c.1. Pressure;

b.2.c.2. Cycle time;

b.2.d. "Hot isostatic densification" of titanium alloys, aluminum alloys or "superalloys":

b.2.d.1. Temperature;

b.2.d.2. Pressure;

b.2.d.3. Cycle time;

c. "Technology" for the "development" or "production" of hydraulic stretch-forming machines and dies therefor, for the manufacture of airframe structures;
d. "Technology" for the "development" of generators of machine tool instructions (e.g., part programs) from design data residing inside "numerical control" units;

e. "Technology" for the "development" of integration "software" for incorporation of expert systems for advanced decision support of shop floor operations into "numerical control" units;

f. "Technology" for the application of inorganic overlay coatings or inorganic surface modification coatings (specified in column 3 of the following table) to non-electronic substrates (specified in column 2 of the following table), by processes specified in column 1 of the following table and defined in the Technical Note.

N.B. *This table should be read to control the technology of a particular 'Coating Process' only when the resultant coating in column 3 is in a paragraph directly across from the relevant 'Substrate' under column 2. For example, Chemical Vapor Deposition (CVD) 'coating process' technical data are controlled for the application of 'silicides' to 'Carbon-carbon, Ceramic and Metal "matrix" "composites" substrates, but are not controlled for the application of 'silicides' to 'Cemented tungsten carbide (16), Silicon carbide (18)' substrates. In the second case, the resultant coating is not listed in the paragraph under column 3 directly across from the paragraph under column 2 listing 'Cemented tungsten carbide (16), Silicon carbide (18)'.*

Category 2E - Materials Processing Table; Deposition Techniques

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
A. Chemical Vapor Deposition (CVD)	"Superalloys"	Aluminides for internal passages
	Ceramics (19) and Low-expansion glasses(14)	Silicides Carbides Dielectric layers (15) Diamond Diamond-like carbon (17)
	Carbon-carbon, Ceramic, and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Aluminides Alloyed aluminides (2) Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)

[1] The numbers in parenthesis refer to the Notes following this Table.

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
	Beryllium and Beryllium alloys	Dielectric layers (15) Diamond Diamond-like carbon (17)
	Sensor window materials (9)	Dielectric layers (15) Diamond Diamond-like carbon (17)
B. Thermal-Evaporation Physical Vapor		
1. Physical Vapor Deposition (PVD): Deposition (TE-PVD) Electron-Beam (EB-PVD)	"Superalloys"	Alloyed silicides Alloyed aluminides (2) MCrAlX (5) Modified zirconia (12) Silicides Aluminides Mixtures thereof (4)
	Ceramics (19) and Low-expansion glasses (14)	Dielectric layers (15)
	Corrosion resistant steel (7)	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
	Beryllium and Beryllium alloys	Dielectric layers (15) Borides Beryllium
	Sensor window materials (9)	Dielectric layers (15)
	Titanium alloys (13)	Borides Nitrides
2. Ion assisted resistive heating Physical Vapor Deposition (PVD)(Ion Plating)	Ceramics (19) and Low-expansion glasses (14)	Dielectric layers (15) Diamond-like carbon (17)
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Dielectric layers (15)
	Cemented tungsten carbide (16) Silicon carbide	Dielectric layers (15)
	Molybdenum and Molybdenum alloys	Dielectric Layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric Layers (15) Diamond-like carbon (17)
3. Physical Vapor Deposition (PVD): "Laser" Vaporization	Ceramics (19) and Low-expansion glasses (14)	Silicides Dielectric layers (15) Diamond-like carbon (17)
	Carbon-carbon,Ceramic and Metal "matrix" "composites"	Dielectric layers (15)
	Cemented tungsten carbide (16), Silicon carbide	Dielectric Layers (15)
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Dielectric layers (15)
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon
4. Physical Vapor Deposition (PVD): Cathodic Arc Discharge.	"Superalloys"	Alloyed silicides Alloyed Aluminides (2) MCrA1X (5)

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
	Polymers (11) and Organic "matrix" "composites"	Borides Carbides Nitrides Diamond-like carbon (17)
C. Pack cementation (see A above for out-of-pack cementation) (10)	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Mixtures thereof (4)
	Titanium alloys (13)	Silicides Aluminides Alloyed aluminides (2)
	Refractory metals and alloys (8)	Silicides Oxides
D. Plasma spraying	"Superalloys"	MCrAlX (5) Modified zirconia (12) Mixtures thereof (4) Abradable Nickel-Graphite Abradable materials containing Ni-Cr-Al Abradable Al-Si-Polyester Alloyed aluminides (2)
	Aluminum alloys (6)	MCrAlX (5) Modified zirconia (12) Silicides Mixtures thereof (4)

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
	Refractory metals and alloys (8), Carbides, Corrosion resistant steel (7)	Aluminides Silicides MCrAlX (5) Modified zirconia (12) Mixtures thereof (4)
D. Plasma spraying (continued)	Titanium alloys (13)	Carbides Aluminides Silicides Alloyed aluminides (2)
	Abradable Nickel Graphite	Abradable materials containing Ni-Cr-Al Abradable Al-Si-Polyester
E. Slurry Deposition	Refractory metals and alloys (8)	Fused silicides Fused aluminides except for resistance heating elements
	Carbon-carbon, Ceramic and Metal "matrix" "composites"	Silicides Carbides Mixtures thereof (4)
F. Sputter Deposition	"Superalloys"	Alloyed silicides Alloyed aluminides (2) Noble metal modified aluminides (3) MCrAlX (5) Modified zirconia (12) Platinum Mixtures thereof (4)

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
	Ceramics and Low-expansion glasses (14)	Silicides Platinum Mixtures thereof (4) Dielectric layers (15) Diamond-like carbon (17)
	Titanium alloys (13)	Borides Nitrides Oxides Silicides Aluminides Alloyed aluminides (2) Carbides
F. Sputter Deposition (continued)	Carbon-carbon, Ceramic and Metal "matrix" "Composites"	Silicides Carbides Refractory metals Mixtures thereof (4) Dielectric layers (15) Boron nitride
	Cemented tungsten carbide (16), Silicon carbide (18)	Carbides Tungsten Mixtures thereof (4) Dielectric layers (15) Boron nitride
	Molybdenum and Molybdenum alloys	Dielectric layers (15)
	Beryllium and Beryllium alloys	Borides Dielectric layers (15) Beryllium
	Sensor window materials (9)	Dielectric layers (15) Diamond-like carbon (17)
	Refractory metals and alloys (8)	Aluminides Silicides Oxides Carbides
G. Ion Implantation	High temperature bearing steels	Additions of Chromium,Tantalum, or Niobium (Columbium)

1. *Coating Process* (1)[1]	2. *Substrate*	3. *Resultant Coating*
	Titanium alloys (13)	Borides Nitrides
	Beryllium and Beryllium alloys	Borides
	Cemented tungsten carbide (16)	Carbides Nitrides

Notes to Table on Deposition Techniques:

1. The term "coating process" includes coating repair and refurbishing as well as original coating.

2. The term "alloyed aluminide coating" includes single or multiple-step coatings in which an element or elements are deposited prior to or during application of the aluminide coating, even if these elements are deposited by another coating process. It does not, however, include the multiple use of single-step pack cementation processes to achieve alloyed aluminides.

3. The term "noble metal modified aluminide" coating includes multiple-step coatings in which the noble metal or noble metals are laid down by some other coating process prior to application of the aluminide coating.

4. The term "mixtures thereof" includes infiltrated material, graded compositions, co-deposits and multilayer deposits and are obtained by one or more of the coating processes specified in the Table.

5. MCrAlX refers to a coating alloy where M equals cobalt, iron, nickel or combinations thereof and X equals hafnium, yttrium, silicon, tantalum in any amount or other intentional additions over 0.01% by weight in various proportions and combinations, except:

a. CoCrAlY coatings which contain less than 22% by weight of chromium, less than 7% by weight of aluminum and less than 2% by weight of yttrium;

b. CoCrAlY coatings which contain 22 to 24% by weight of chromium, 10 to 12% by weight of aluminum and 0.5 to 0.7% by weight of yttrium; or

c. NiCrAlY coatings which contain 21 to 23% by weight of chromium, 10 to 12% by weight of aluminum and 0.9 to 1.1% by weight of yttrium.

6. The term "aluminum alloys" refers to alloys having an ultimate tensile strength of 190 MPa or more measured at 293 K (20 °C).

7. The term "corrosion resistant steel" refers to AISI (American Iron and Steel Institute) 300 series or equivalent national standard steels.

8. "Refractory metals and alloys" include the following metals and their alloys: niobium (columbium), molybdenum, tungsten and tantalum.

9. "Sensor window materials", as follows: alumina, silicon, germanium, zinc sulphide, zinc selenide, gallium arsenide, diamond, gallium phosphide, sapphire and the following metal halides: sensor window materials of more than 40 mm diameter for zirconium fluoride and hafnium fluoride.

10. "Technology" for single-step pack cementation of solid airfoils is not controlled by Category 2.

11. "Polymers", as follows: polyimide, polyester, polysulfide, polycarbonates and polyurethanes.

12. "Modified zirconia" refers to additions of other metal oxides, (e.g., calcia, magnesia, yttria, hafnia, rare earth oxides) to zirconia in order to stabilize certain crystallographic phases and phase compositions. Thermal barrier coatings made of zirconia, modified with calcia or magnesia by mixing or fusion, are not controlled.

13. "Titanium alloys" refers only to aerospace alloys having an ultimate tensile strength of 900 MPa or more measured at 293 K (20 °C).

14. "Low-expansion glasses" refers to glasses which have a coefficient of thermal expansion of 1 x 10^{-7} K^{-1} or less measured at 293 K (20 °C).

15. "Dielectric layers" are coatings constructed of multi-layers of insulator materials in which the interference properties of a design composed of materials of various refractive indices are used to reflect, transmit or absorb various wavelength bands. Dielectric layers refers to more than four dielectric layers or dielectric/metal "composite" layers.

16. "Cemented tungsten carbide" does not include cutting and forming tool materials consisting of tungsten carbide/(cobalt, nickel), titanium carbide/(cobalt, nickel), chromium carbide/nickel-chromium and chromium carbide/nickel.

17. "Technology" specially designed to deposit diamond-like carbon on any of the following is not controlled: magnetic disk drives and heads, equipment for the manufacture of disposables, valves for faucets, acoustic diaphragms for speakers, engine parts for automobiles, cutting tools, punching-pressing dies, office automation equipment, microphones, medical devices or molds, for casting or molding of plastics, manufactured from alloys containing less than 5% beryllium.

18. "Silicon carbide" does not include cutting and forming tool materials.

19. Ceramic substrates, as used in this entry, does not include ceramic materials containing 5% by weight, or greater, clay or cement content, either as separate constituents or in combination.

Technical Note to Table on Deposition Techniques: *Processes specified in Column 1 of the Table are defined as follows:*

a. Chemical Vapor Deposition (CVD) is an overlay coating or surface modification coating process wherein a metal, alloy, "composite", dielectric or ceramic is deposited upon a heated substrate. Gaseous reactants are decomposed or combined in the vicinity of a substrate resulting in the deposition of the desired elemental, alloy or compound material on the substrate. Energy for this decomposition or chemical reaction process may be provided by the heat of the substrate, a glow discharge plasma, or "laser" irradiation.

Note 1: *CVD includes the following processes: directed gas flow out-of-pack deposition, pulsating CVD, controlled nucleation thermal decomposition (CNTD), plasma enhanced or plasma assisted CVD processes.*

Note 2: *Pack denotes a substrate immersed in a powder mixture.*

Note 3: *The gaseous reactants used in the out-of-pack process are produced using the same basic reactions and parameters as the pack cementation process, except that the substrate to be coated is not in contact with the powder mixture.*

b. Thermal Evaporation-Physical Vapor Deposition (TE-PVD) is an overlay coating

process conducted in a vacuum with a pressure less than 0.1 Pa wherein a source of thermal energy is used to vaporize the coating material. This process results in the condensation, or deposition, of the evaporated species onto appropriately positioned substrates. The addition of gases to the vacuum chamber during the coating process to synthesize compound coatings is an ordinary modification of the process. The use of ion or electron beams, or plasma, to activate or assist the coating's deposition is also a common modification in this technique. The use of monitors to provide in-process measurement of optical characteristics and thickness of coatings can be a feature of these processes. Specific TE-PVD processes are as follows:

1. Electron Beam PVD uses an electron beam to heat and evaporate the material which forms the coating;

2. Ion Assisted Resistive Heating PVD employs electrically resistive heating sources in combination with impinging ion beam(s) to produce a controlled and uniform flux of evaporated coating species;

3. "Laser" Vaporization uses either pulsed or continuous wave "laser" beams to vaporize the material which forms the coating;

4. Cathodic Arc Deposition employs a consumable cathode of the material which forms the coating and has an arc discharge established on the surface by a momentary contact of a ground trigger. Controlled motion of arcing erodes the cathode surface creating a highly ionized plasma. The anode can be either a cone attached to the periphery of the cathode, through an insulator, or the chamber. Substrate biasing is used for non line-of-sight deposition.

Note: *This definition does not include random cathodic arc deposition with non-biased substrates.*

5. Ion Plating is a special modification of a general TE-PVD process in which a plasma or an ion source is used to ionize the species to be deposited, and a negative bias is applied to the substrate in order to facilitate the extraction of the species from the plasma. The introduction of reactive species, evaporation of solids within the process chamber, and the use of monitors to provide in-process measurement of optical characteristics and thicknesses of coatings are ordinary modifications of the process.

c. Pack Cementation is a surface modification coating or overlay coating process wherein a substrate is immersed in a powder mixture (a pack), that consists of:

1. The metallic powders that are to be deposited (usually aluminum, chromium, silicon or combinations thereof);

2. An activator (normally a halide salt); and

3. An inert powder, most frequently alumina.

Note: *The substrate and powder mixture is contained within a retort which is heated to between 1,030 K (757 °C) to 1,375 K (1,102 °C) for sufficient time to deposit the coating.*

d. Plasma Spraying is an overlay coating process wherein a gun (spray torch) which produces and controls a plasma accepts powder or wire coating materials, melts them and propels them towards a substrate, whereon an integrally bonded coating is formed. Plasma spraying constitutes either low pressure plasma spraying or high velocity plasma spraying.

Note 1: *Low pressure means less than ambient atmospheric pressure.*

Note 2: *High velocity refers to nozzle-exit gas velocity exceeding 750 m/s calculated at 293 K (20 °C) at 0.1 MPa.*

e. Slurry Deposition is a surface modification coating or overlay coating process wherein a metallic or ceramic powder with an organic binder is suspended in a liquid and is applied to a substrate by either spraying, dipping or painting, subsequent air or oven drying, and heat treatment to obtain the desired coating.

f. Sputter Deposition is an overlay coating process based on a momentum transfer phenomenon, wherein positive ions are accelerated by an electric field towards the surface of a target (coating material). The kinetic energy of the impacting ions is sufficient to cause target surface atoms to be released and deposited on an appropriately positioned substrate.

Note 1: *The Table refers only to triode, magnetron or reactive sputter deposition which is used to increase adhesion of the coating and rate of deposition and to radio frequency (RF) augmented sputter deposition used to permit vaporization of non-metallic coating materials.*

Note 2: *Low-energy ion beams (less than 5 keV) can be used to activate the deposition.*

g. Ion Implantation is a surface modification coating process in which the element to be alloyed is ionized, accelerated through a potential gradient and implanted into the surface region of the substrate. This includes processes in which ion implantation is performed simultaneously with electron beam physical vapor deposition or sputter deposition.

Accompanying Technical Information to Table on Deposition Techniques:

1. "Technology" for pretreatments of the substrates listed in the Table, as follows:

a. Chemical stripping and cleaning bath cycle parameters, as follows:

1. Bath composition;

a. For the removal of old or defective coatings corrosion product or foreign deposits;

b. For preparation of virgin substrates;

2. Time in bath;

3. Temperature of bath;

4. Number and sequences of wash cycles;

b. Visual and macroscopic criteria for acceptance of the cleaned part;

c. Heat treatment cycle parameters, as follows:

1. Atmosphere parameters, as follows:

a. Composition of the atmosphere;

b. Pressure of the atmosphere;

2. Temperature for heat treatment;

3. Time of heat treatment;

d. Substrate surface preparation parameters, as follows:

1. Grit blasting parameters, as follows:

a. Grit composition;

b. Grit size and shape;

c. Grit velocity;

2. Time and sequence of cleaning cycle after grit blast;

3. Surface finish parameters;

4. Application of binders to promote adhesion;

e. Masking technique parameters, as follows:

1. Material of mask;

2. Location of mask;

2. "Technology" for in situ quality assurance techniques for evaluation of the coating processes listed in the Table, as follows:

a. Atmosphere parameters, as follows:

1. Composition of the atmosphere;

2. Pressure of the atmosphere;

b. Time parameters;

c. Temperature parameters;

d. Thickness parameters;

e. Index of refraction parameters;

f. Control of composition;

3. "Technology" for post deposition treatments of the coated substrates listed in the Table, as follows:

a. Shot peening parameters, as follows:

1. Shot composition;

2. Shot size;

3. Shot velocity;

b. Post shot peening cleaning parameters;

c. Heat treatment cycle parameters, as follows:

1. Atmosphere parameters, as follows:

a. Composition of the atmosphere;

b. Pressure of the atmosphere;

2. Time-temperature cycles;

d. Post heat treatment visual and macroscopic criteria for acceptance of the coated substrates;

4. "Technology" for quality assurance techniques for the evaluation of the coated substrates listed in the Table, as follows:

a. Statistical sampling criteria;

b. Microscopic criteria for:

1. Magnification;

2. Coating thickness, uniformity;

3. Coating integrity;

4. Coating composition;

5. Coating and substrates bonding;

6. Microstructural uniformity.

c. Criteria for optical properties assessment (measured as a function of wavelength):

1. Reflectance;

2. Transmission;

3. Absorption;

4. Scatter;

5. "Technology" and parameters related to specific coating and surface modification processes listed in the Table, as follows:

a. For Chemical Vapor Deposition (CVD):

1. Coating source composition and

formulation;

2. Carrier gas composition;

3. Substrate temperature;

4. Time-temperature-pressure cycles;

5. Gas control and part manipulation;

b. For Thermal Evaporation-Physical Vapor Deposition (PVD):

1. Ingot or coating material source composition;

2. Substrate temperature;

3. Reactive gas composition;

4. Ingot feed rate or material vaporization rate;

5. Time-temperature-pressure cycles;

6. Beam and part manipulation;

7. "Laser" parameters, as follows:

a. Wave length;

b. Power density;

c. Pulse length;

d. Repetition ratio;

e. Source;

c. For Pack Cementation:

1. Pack composition and formulation;

2. Carrier gas composition;

3. Time-temperature-pressure cycles;

d. For Plasma Spraying:

1. Powder composition, preparation and size distributions;

2. Feed gas composition and parameters;

3. Substrate temperature;

4. Gun power parameters;

5. Spray distance;

6. Spray angle;

7. Cover gas composition, pressure and flow rates;

8. Gun control and part manipulation;

e. For Sputter Deposition:

1. Target composition and fabrication;

2. Geometrical positioning of part and target;

3. Reactive gas composition;

4. Electrical bias;

5. Time-temperature-pressure cycles;

6. Triode power;

7. Part manipulation;

f. For Ion Implantation:

1. Beam control and part manipulation;

2. Ion source design details;

3. Control techniques for ion beam and deposition rate parameters;

4. Time-temperature-pressure cycles.

g. For Ion Plating:

1. Beam control and part manipulation;

2. Ion source design details;

3. Control techniques for ion beam and deposition rate parameters;

4. Time-temperature-pressure cycles;

5. Coating material feed rate and vaporization rate;

6. Substrate temperature;

7. Substrate bias parameters.

2E018 "Technology" for the "use" of equipment controlled by 2B018.

License Requirements

Reason for Control: NS, MT, AT, UN

Control(s)	*Country Chart*
NS applies to entire entry	NS Column 1
MT applies to "technology" for equipment controlled by 2B018 for MT reasons	MT Column 1
AT applies to entire entry	AT Column 1
UN applies to entire entry	See § 746.1(b) for UN controls.

License Exceptions

CIV: N/A
TSR: Yes.

List of Items Controlled

Unit: N/A
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2E101 "Technology" according to the General Technology Note for the "use" of equipment or "software" controlled by 2B004, 2B009, 2B104, 2B105, 2B109, 2B116, 2B117, 2B119 to 2B122, 2D001, 2D002 or 2D101.

License Requirements

Reason for Control: MT, NP, AT

Control(s)	*Country Chart*
MT applies to "technology" for items controlled by 2B004, 2B009, 2B104, 2B105, 2B109, 2B116, 2B117, 2B119 to 2B122, 2D001, or 2D101 for MT reasons	MT Column 1
NP applies to "technology" for items controlled by 2B004, 2B009, 2B104, 2B109, 2B116, 2D001, 2D002 or 2D101 for NP reasons	NP Column 1
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: N/A
Related Controls: (1) This entry controls only "technology" for 2B009 and 2B109 for spin forming machines combining the functions of spin forming and flow forming, and flow forming machines. (2) Also see

2E201.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2E201 "Technology" according to the General Technology Note for the "use" of equipment or "software" controlled by 2A225, 2A226, 2B001, 2B006, 2B007.b, 2B007.c, 2B201, 2B204, 2B206, 2B207, 2B209, 2B225 to 2B232, 2D002, 2D201 or 2D202 for NP reasons.

License Requirements

Reason for Control: NP, CB, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 1
CB applies to "technology" for valves controlled by 2A226 that meet or exceed the technical parameters in 2B350.g	CB Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: N/A
Related Controls: Also see 2E290 and 2E991.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2E290 "Technology" according to the General Technology Note for the "use" of equipment controlled by 2A290, 2A291, 2A292, 2A293, or 2B290.

License Requirements

Reason for Control: NP, CB, AT

Control(s)	*Country Chart*
NP applies to entire entry	NP Column 2
CB applies to "technology" for valves controlled by 2A292 that meet or exceed the technical parameters in 2B350.g	CB Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: N/A
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2E301 "Technology" according to the "General Technology Note" for "use" of items controlled by 2B350, 2B351 and 2B352.

License Requirements

Reason for Control: CB, AT

Control(s)	*Country Chart*

CB applies to entire entry	CB Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: N/A
Related Controls: N/A
Related Definitions: N/A
Items:

The lists of items controlled are contained in the ECCN headings.

2E983 "Technology" specially designed or modified for the "development", "production" or "use" of equipment controlled by 2A983, or the "development" of software controlled by 2D983.

License Requirements

Reason for Control: RS, AT

Control(s)	*Country Chart*
RS applies to entire entry	RS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: N/A
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2E984 "Technology" "required" for the "development, "production" or "use" of equipment controlled by 2A984 or "required" for the "development" of "software" controlled by 2D984.

License Requirements

Reason for Control: RS, AT

Control(s)	*Country Chart*
RS applies to entire entry	RS Column 2
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: $ value
Related Controls: (1) "Technology" "required" for the "development", "production" or "use" of concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution less than 0.5 milliradian (a lower milliradian number means a more accurate image resolution) at a standoff distance of 100 meters or "required" for the "development" of "software" "required" for the "development", "production" or "use" of concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution less than 0.5 milliradian at a standoff distance of 100 meters is under the export licensing authority of the U.S. Department of State (22 CFR parts 120 through 130). (2) "Technology" "required" for the "development",

"production" or "use" of concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution greater than 1 milliradian spatial resolution (a higher milliradian number means a less accurate image resolution) at a standoff distance of 100 meters or "required" for the "development" of "software" "required" for the "development", "production" or "use" of concealed object detection equipment operating in the frequency range from 30 GHz to 3000 GHz and having a spatial resolution greater than 1 milliradian spatial resolution (a higher milliradian number means a less accurate image resolution) at a standoff distance of 100 meters is designated as EAR99. (3) See ECCNs 2A984 and 2D984 for related commodity and software controls.
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2E991 "Technology" for the "use" of equipment controlled by 2B991, 2B993, 2B996, or 2B997.

License Requirements

Reason for Control: AT

Control(s)	*Country Chart*
AT applies to entire entry	AT Column 1

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: N/A
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

2E994 "Technology" for the "use" of portable electric generators controlled by 2A994.

License Requirements

Reason for Control: AT

Control(s)

AT applies to entire entry. A license is required for items controlled by this entry to Cuba, Iran and North Korea for anti terrorism reasons. The Commerce Country Chart is not designed to determine licensing requirements for this entry. See part 746 of the EAR for additional information on Cuba and Iran. See §742.19 of the EAR for additional information on North Korea.

License Exceptions

CIV: N/A
TSR: N/A

List of Items Controlled

Unit: N/A
Related Controls: N/A
Related Definitions: N/A
Items:

The list of items controlled is contained in the ECCN heading.

EAR99 Items subject to the EAR that are *not* elsewhere specified in this CCL Category *or* in any other category in the CCL are designated by the number *EAR99*.